JESENSKI ROK 2013.

① $U_{ef} = 220\,V$

$f = 50\,Hz$

$t = \frac{1}{300}\,s$ nakon U_{MAX}

$u\left(\frac{T}{4}+t\right) = ?$

$U_{MAX} = 311\,V$ $\omega = 2\pi f = 314{,}16\ rad/s$

$u(t) = U_M \sin(\omega t)$

$u\left(\frac{T}{4}+t\right) = U_M \sin\left[\omega\left(\frac{T}{4}+t\right)\right]$

$T = \frac{1}{f} = \frac{1}{50}\,s$

$\left(\frac{T}{4}+t\right) = \frac{1}{200} + \frac{1}{300} = \frac{1}{120}\,s$

$u\left(\frac{T}{4}+t\right) = 311 \cdot \sin\left(\frac{5\pi}{6}\right)$

$u\left(\frac{T}{4}+t\right) = 155{,}5\,V$

② $u(t) = 100\cos\left(\omega t + \frac{\pi}{2}\right)\,V$ $\quad -\sin t$

$u(t) = -100 \cdot \sin(\omega t)\,V$

$i(t) = 1\sin\left(\omega t + \frac{2\pi}{3}\right)\,A$

$i(t) = 1\sin\left(\omega t + \frac{2\pi}{3}\right)\,A$

$X'(z) = \frac{1}{3}X(z)$

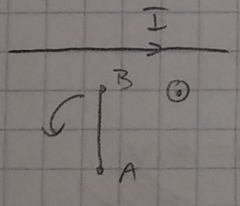
$I' = ?$

$$Z = \frac{-\frac{100}{\sqrt{2}}}{\frac{\sqrt{2}}{2}\angle 120^\circ} = 100\angle -60^\circ = 50 - j50\sqrt{3}\,\Omega$$

$$Z' = 50 + \frac{j\frac{50\sqrt{3}}{1}}{\frac{3}{1}} = 50 + j\frac{50\sqrt{3}}{3}\,\Omega$$

$$I' = \frac{-\frac{100}{\sqrt{2}}}{50 + j\frac{50\sqrt{3}}{3}} = \frac{\sqrt{6}}{2}\angle 150^\circ\,A$$

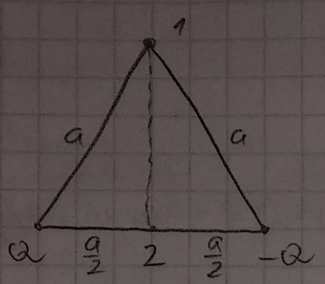
③



$\varphi_a \neq \varphi_b \Rightarrow U_{ab} > 0$

a) U_{ab} u svakom trenutku pos.

④.



(2)...

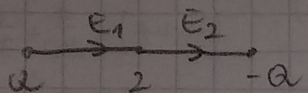
$$E_1 = \frac{Q}{4\pi\varepsilon\left(\frac{a}{2}\right)^2} = \frac{Q}{4\pi\varepsilon\frac{a^2}{4}} = 4\frac{Q}{4\pi\varepsilon a^2}$$

$$E_2 = \frac{-Q}{4\pi\varepsilon\left(\frac{a}{2}\right)^2} = -4\frac{Q}{4\pi\varepsilon a^2}$$

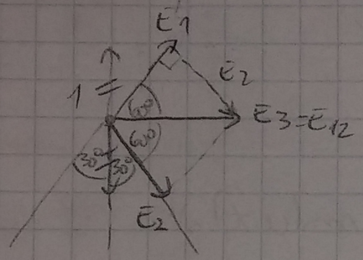
} ISTI SMJER

$$\vec{E} = \vec{E}_1 - \vec{E}_2 = 8\frac{Q}{4\pi\varepsilon a^2}$$

(2)



(1)



$$E_1 = \frac{Q}{4\pi\varepsilon a^2} \qquad E_2 = \frac{-Q}{4\pi\varepsilon a^2}$$

$$E_{12} = |E_{1\parallel}| + |E_{2\parallel}| \qquad |E_1| = |E_2| = |E|$$

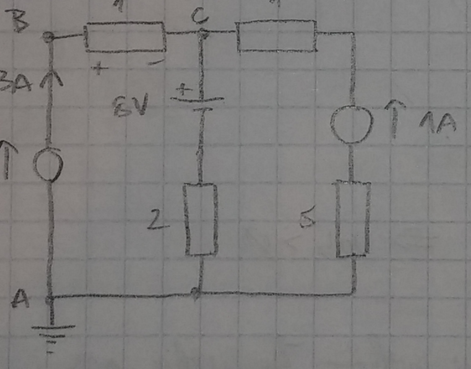
$$E_{12} = E_1\cos 60° + E_2\cos 60° = \cos 60° \cdot 2E = \frac{Q}{4\pi\varepsilon a^2}$$

$$\frac{E(2)}{E(1)} = \frac{8\cdot\frac{Q}{4\pi\varepsilon a^2}}{\frac{Q}{4\pi\varepsilon a^2}} = 8$$

⑤.

$\varphi_a = 0\,V$

$\varphi_b = ?$



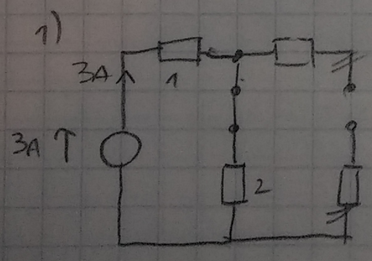
$$U_{ca} = \frac{3 + \frac{8}{2} + 1}{\frac{1}{2}} = \frac{3+4+1}{\frac{1}{2}} = \frac{8}{\frac{1}{2}} = 16\,V$$

$\varphi_c = +16\,V$

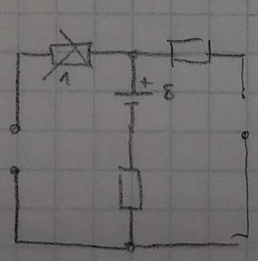
$\varphi_b = \varphi_c + 3\cdot 1 = 19\,V$

SUPERPOZICIJA

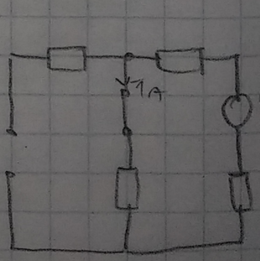
1)



2)



3)

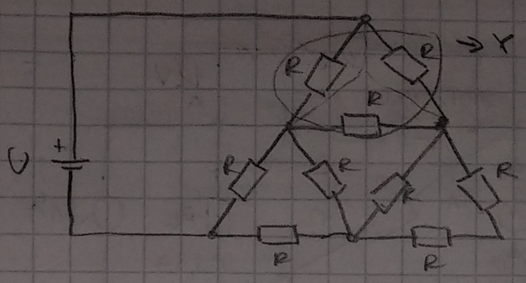


⑥

$I = ?$

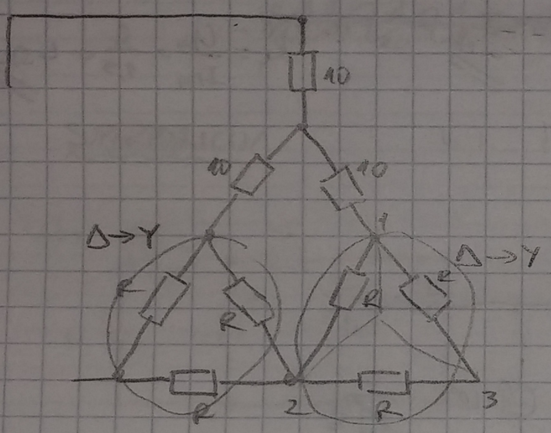
$U = 200\,V$

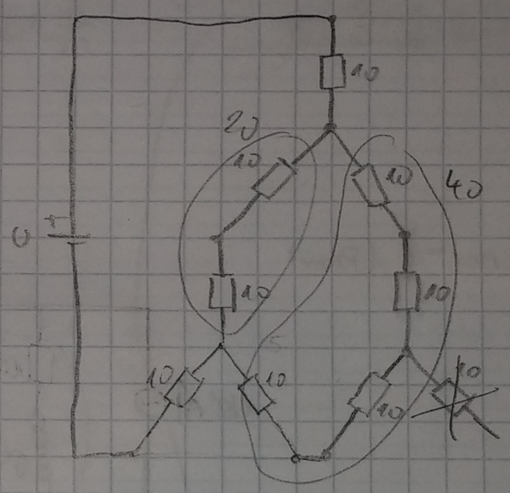
$R = 30\,\Omega$



$\Delta \to Y \qquad R_{12} = R_{23} = R_{31} = 30\,\Omega$

$$R_1 = R_2 = R_3 = \frac{R_{12} \cdot R_{23}}{R_{12} + R_{23} + R_{31}} = 10\,\Omega$$





$$R_{UK} = 20 + (20 \,||\, 40) = \frac{100}{3}\,\Omega$$

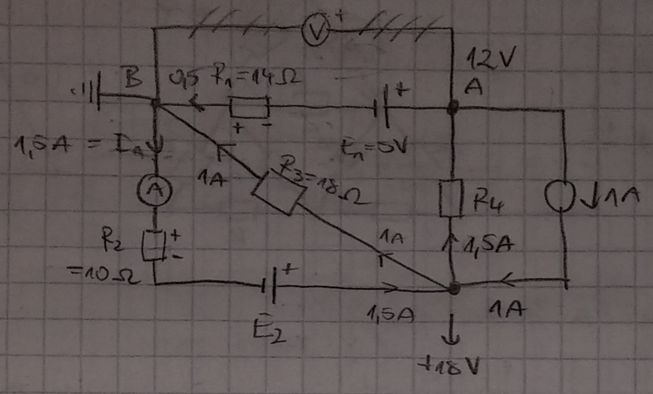
$$I_{UK} = \frac{U}{R_{UK}} = \frac{200}{\frac{100}{3}} = 6\,A$$

7.

$I_A = 1{,}5\,A$

$U_V = U_{AB} = 12\,V$

$R_4 = ?$



$-14I + 5 - 12 = 0$

$-14I = 7$

$I = -\frac{1}{2}\,A$

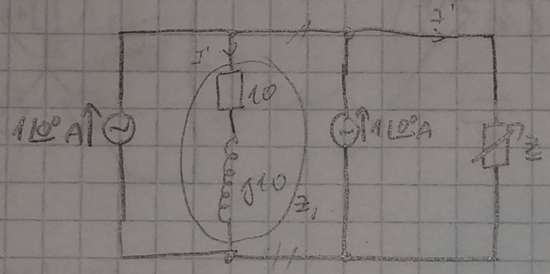
$U_{R_4} = 18 - 12 = 6\,V$

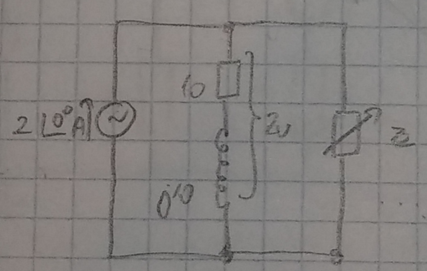
$I_{R_4} = 1{,}5\,A$

$R_4 = \frac{U_{R_4}}{I_{R_4}} = \frac{6}{1{,}5} = 4\,\Omega$

8.

$\underline{Z}_{MAX} = ?$ (Pmax)





$\underline{Z}_1 = 10 + j10$

$\underline{Z} = \underline{Z}^*$

$\underline{Z} = 10 - j10\,\Omega$

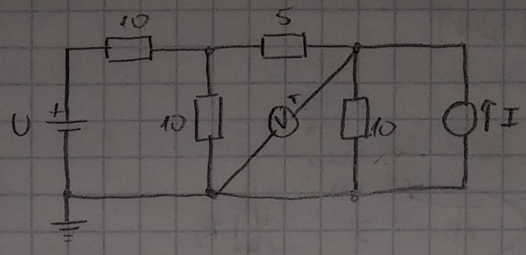
$\underline{Z} = 10\sqrt{2}\angle -45°\,\Omega$

⑨

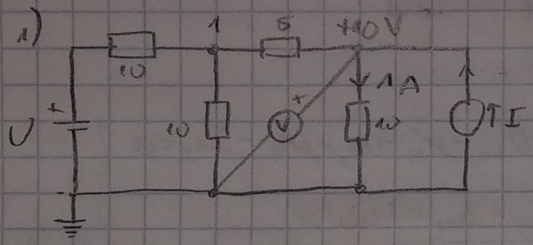
$U_V = 10\,V$

$I' = 2I \dots U_V = 10\,V$

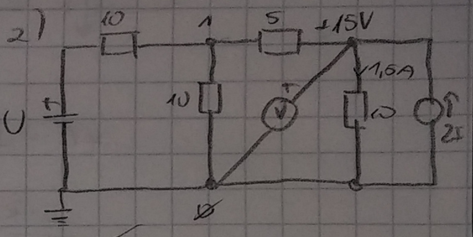
$U = ?$



1)



2)

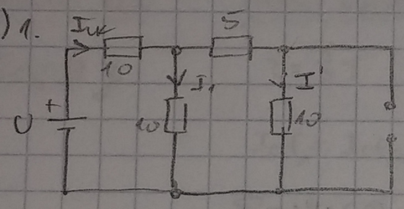


~~$\frac{1}{10} + \frac{1}{10} + \frac{1}{5} = \frac{1}{10} + \frac{1}{5} = \frac{U}{10}$~~

~~$\frac{1}{10} + \frac{1}{10} + \frac{1}{5} = \frac{1}{5} + \frac{1}{5} = \frac{U}{10}$~~

SUPERPOZICIJA

1) 1.

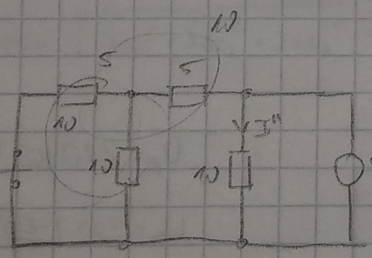


$R_{VK} = 10 + (10 \,||\, 15) = 10 + \frac{150}{25} = 16\,\Omega$

$I'_{VK} = \frac{U}{16}\,A$

$I' = I'_{VK} \cdot \frac{10}{25} = \frac{U}{16} \cdot \frac{2}{5} = \frac{U}{40}\,A$

1) 2.



$R_{VK}\ 10 \,||\, 10 = 5\,\Omega$

$I'' = \frac{I}{2}$

$I' + I'' = 1\,A$

$I' + 2I'' = 1{,}5\,A$

$\frac{U}{40} + \frac{I}{2} = 1$ -)

$\frac{U}{40} + I = 1{,}5$

$\frac{I}{2} = 0{,}5$

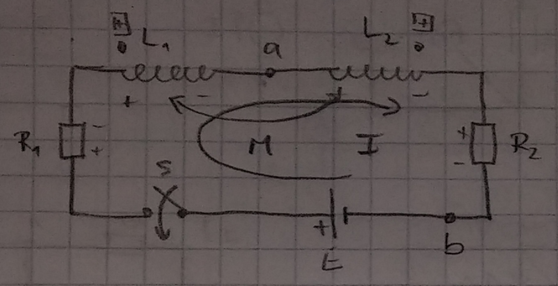
$\boxed{I = 1\,A}$

$\frac{U}{40} + \frac{I}{2} = 1 \,/\cdot 40$

$U + 20I = 40$

$U = 40 - 20 = 20\,V$

(10.) $R = ?$ $(u_{ab}(t=0^+) = 0\,V)$



$$+E - I \cdot R_1 - u_{L_1} - u_M - u_{L_2} + u_M - IR_2 = 0 \quad \Big\}+$$

$$I \cdot R_2 + u_{L_2} - u_M = u_{ab} = 0$$

$$+E - IR_1 - u_{L_1} - u_{L_2} - IR_2 + IR_2 + u_{L_2} - u_M = 0$$

$$+E - IR_1 - u_{L_1} - u_M = 0$$

(11.)

$P_{MAX} = +200\,VA$

$P_{MIN} = -20\,VA$

$\cos\varphi = ?$

$$P_{sr} = \frac{200 - 20}{2} = 90\,W = P$$

$$S = p_{max} - P = 110\,VA$$

$$\cos\varphi = \frac{P}{S} = 0{,}818$$

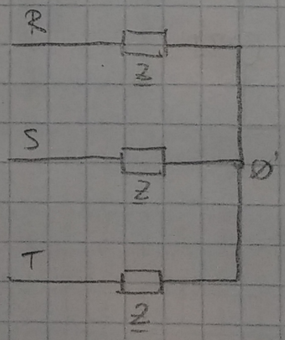
(12.)

$\underline{Z}_1 = \underline{Z}_2 = \underline{Z}_3 = 55\,\angle 45^\circ\,\Omega$

$U_f = 381\,V$

$P = ?$

Y



$U_R = 220\,\angle 0^\circ\,V$ $\quad I_f = 4\,A$

$U_S = 220\,\angle -120^\circ\,V$

$U_T = 220\,\angle -240^\circ\,V$

$$U_f = \frac{U_f}{\sqrt{3}} = 220\,V$$

$\varphi = \alpha_u - \alpha_i \Rightarrow \boxed{\alpha_i = \alpha_u - \varphi}$

$I_R = 4\,\angle -45^\circ\,A \quad \varphi = -45^\circ$

$I_S = 4\,\angle -165^\circ \quad \varphi = 45^\circ$

$I_T = 4\,\angle 75^\circ \quad \varphi = -315^\circ$

$P_1 = U_f \cdot I_R \cdot \cos(-45°) = 622{,}20\ W$

$P_2 = U_f \cdot I_f \cdot \cos(45°) = 622{,}25\ W$

$P_3 = 622{,}25\ W$

$P = P_1 + P_2 + P_3 = 1866{,}76\ W$

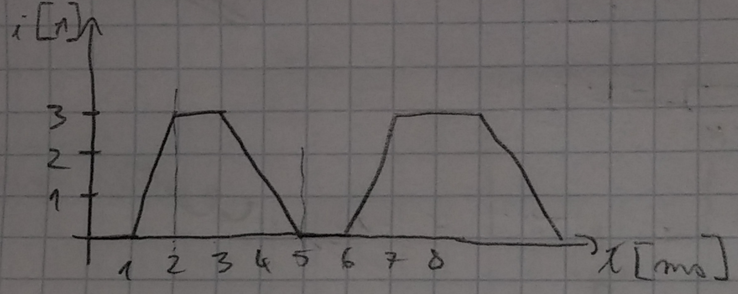
ili

$P = 3U_f I_f \cos(\varphi)$

$P = 1866{,}67\ W$

(13.)

$I_{ef} = ?$



$T = 5\ ms$

PRAVOKUTNI DOLJE

$I_{ef_0} = 0\ V$

PILASTI LIJEVO

$\tau = \frac{1}{5}T \Rightarrow \frac{\tau}{T} = \frac{\frac{1}{5}T}{T} = \frac{1}{5}$

$I_{ef_1} = I_{ef_0} \cdot \sqrt{\frac{\tau}{T}} = \frac{3}{\sqrt{3}} \cdot \frac{1}{\sqrt{5}} = \frac{3}{\sqrt{15}}\ A$

PRAVOKUTNI GORE

$I_{ef_2} = 3 \cdot \sqrt{\frac{1}{5}} = \frac{3}{\sqrt{5}}\ A$

PILASTI DESNO

$\tau = \frac{2}{5}T \Rightarrow \frac{\tau}{T} = \frac{2}{5}$

$I_{ef_3} = \frac{3}{\sqrt{3}} \cdot \frac{\sqrt{2}}{\sqrt{5}} = \frac{3\sqrt{2}}{\sqrt{15}}$

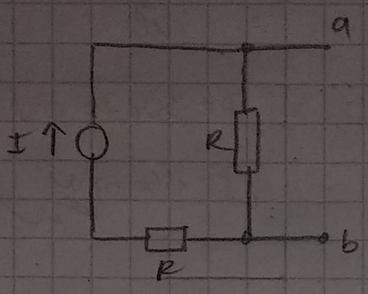
$I_{ef} = \sqrt{I_{ef_1}^2 + I_{ef_2}^2 + I_{ef_3}^2} = 1{,}897\ A$

(14.)

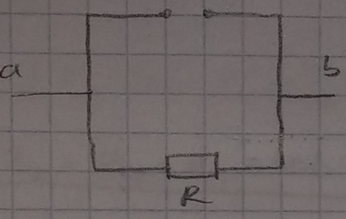
$I = 6A$

$R = 4\Omega$

$I_N, Z_N = ?$

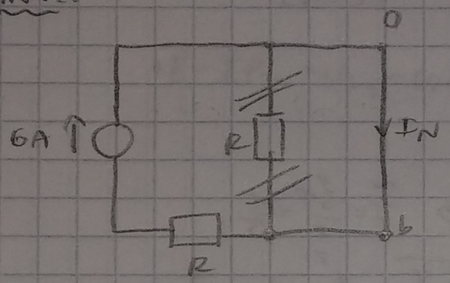


R_N...



$R_N = R = 4\Omega$

I_N...



$I_N = I = 6A$

(15.)

$t = 6ms$

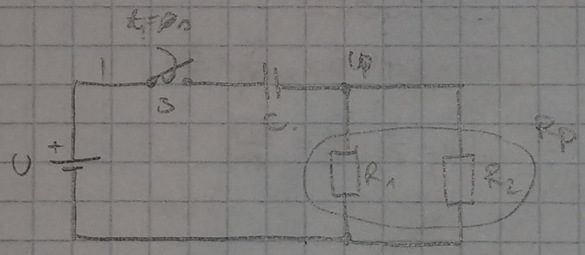
$R_1 = 15000\Omega$

$R_2 = 5000\Omega$

$C = 1\mu F$

$U = 9V$

$u_{R_1}(t_1) = ?$



$R_p = \frac{R_1 R_2}{R_1 + R_2} = 3750\Omega$

$\tau = RC = 3{,}75ms$

$u_C(t=6ms) = U(1 - e^{-\frac{t}{\tau}})$

$u_C(t=6ms) = 9 - 9 \cdot e^{-1{,}6}$

$u_C(t=6ms) = 7{,}18V$

$u_R + u_C = U$

$u_R(t=6ms) = U - u_C(t=6ms)$

$u_R(t=6ms) = 1{,}82V$

(16.)

$R_2 = 2\,\Omega$

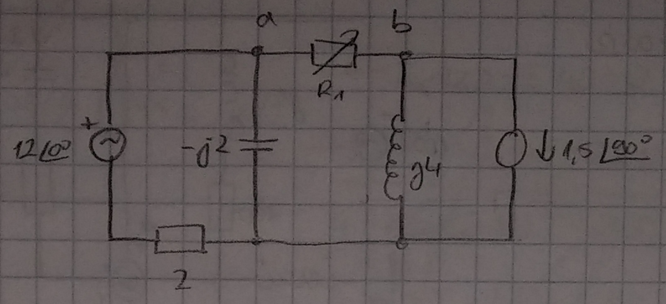
$X_L = 4\,\Omega$

$X_C = 2\,\Omega$

$\dot{U} = 12\angle 0°\,V$

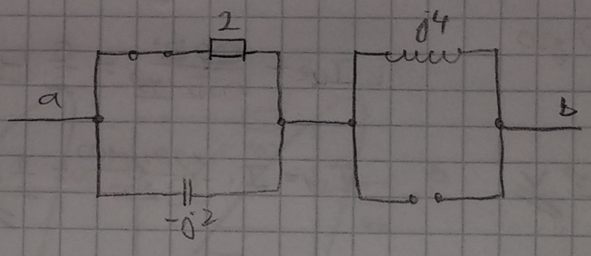
$\dot{I} = 1{,}5\angle 90°\,A$

$P_{MAX} = ?$



NORTON

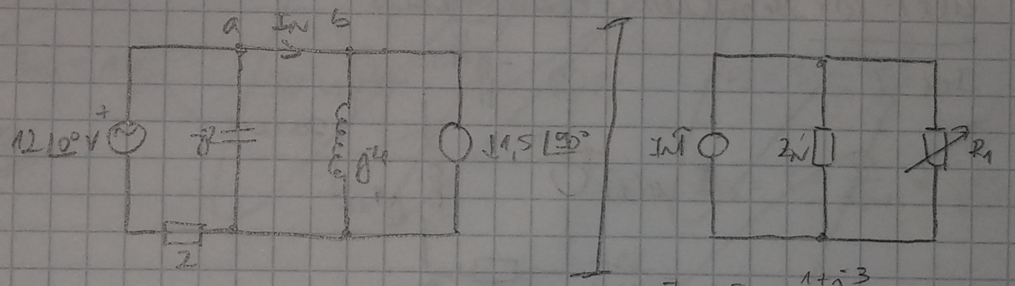
Z_N ...



$Z_N = 2 \,||\, (-j2) + j4 = 1 + j3\,\Omega$

$P_1(P_{max}) = \sqrt{1^2 + 3^2} = \sqrt{10}\,\Omega$

I_N ...

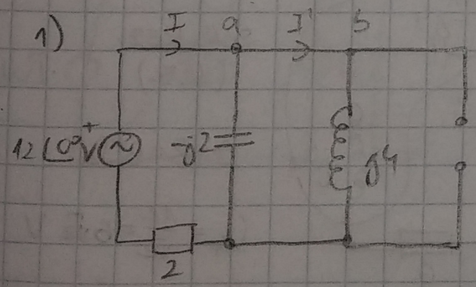


$I_{R_1} = I_N \cdot \frac{1+j3}{1+j3+\sqrt{10}} = 1{,}17\,A$

$P_{R_1} = (I_{R_1})^2 \cdot R_1 = 4{,}33\,W$

SUPERPOZICIJA

1)



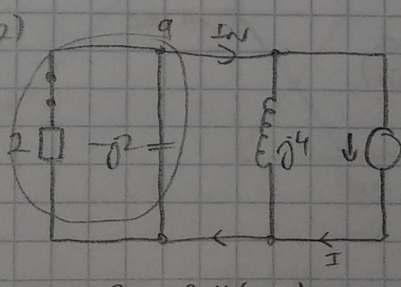
$Z_{UK} = 2 + [(-j2) \,||\, (j4)]$

$Z_{UK} = 2 - j4\,\Omega$

$I = \frac{12\angle 0°}{2 - j4} = 2{,}6833\angle 63{,}43°$

$I' = I \cdot \frac{-j2}{j2} = -\frac{6}{5} - j\frac{12}{5}\,A$

2)



$Z_P = 2 \,||\, (-j2) = 1 - j$

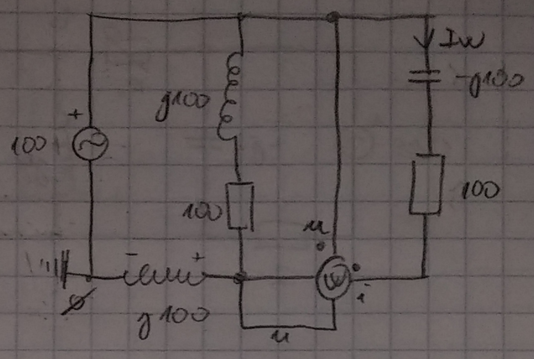
$I_N'' = I \cdot \frac{j4}{1+j3} = -\frac{3}{5} + \frac{9}{5}j\,A$

$I_N = I' + I'' = -\frac{6}{5} - j\frac{12}{5} - \frac{3}{5} + j\frac{9}{5} = -\frac{9}{5} - j\frac{3}{5}\,A$

(17)

$R_1 = R_2 = X_C = X_{L_1} = X_{L_2} = 100\,\Omega$

$U = 100\ V$



$U_w = U - I_{uk} \cdot j100$

$U_w = 100\angle 0° - 50 - j50$

$U_w = 50 - j50$

$U_w = 50\sqrt{2}\angle -45°\ V$

$Z_{uk} = j100 + [(100 + j100) \parallel (100 - j100)] = 100 + j100 = 100\sqrt{2}\angle 45°\ \Omega$

$I_{uk} = \frac{100\angle 0°}{100\sqrt{2}\angle 45°} = \frac{\sqrt{2}}{2}\angle -45°\ A$

$I_w = I \cdot \frac{100 + j100}{200} = \frac{1}{2}\ A$

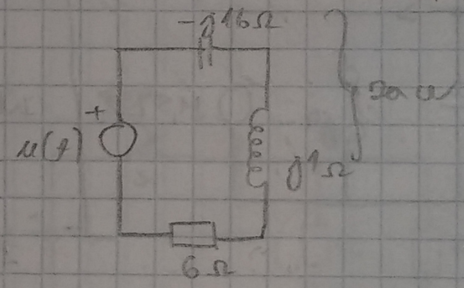
$\varphi = \alpha_u - \alpha_i = -45°$

$P_w = U_w \cdot I_w \cdot \cos(-45°) = 25\ W$

(18)

$u(t) = 10 + 24\sin(2\omega t) + 12\sin(4\omega t)\ V$

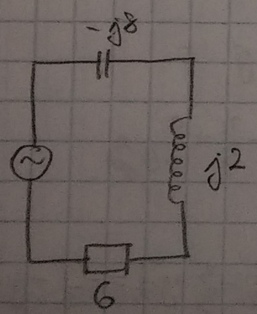
$I_{ef} = ?$



1) $\omega = 0$

$I_{ef} = 0$ (kond. puls.)

2) 2ω

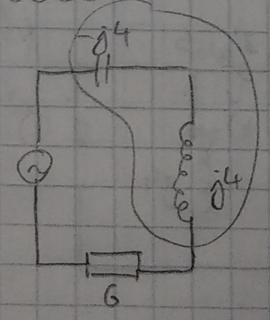


$I_2 = \frac{12\sqrt{2}}{|Z_{2\omega}|}$

$I_2 = \frac{12\sqrt{2}}{\sqrt{6^2 + (-6)^2}} = 2A$

$U_2 = \frac{24}{\sqrt{2}} = 12\sqrt{2}\ V$

3) 4ω



SER. REZ. (K.S.)

$Z = R = 6\,\Omega$

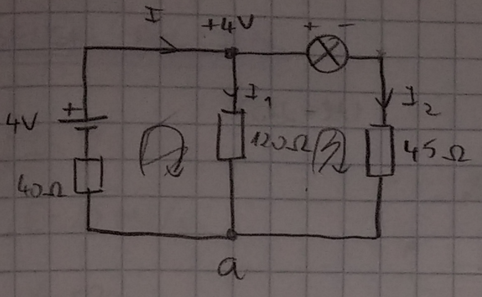
$U_4 = \frac{12}{\sqrt{2}} = 6\sqrt{2}\ V$

$I_4 = \frac{U_4}{R} = \sqrt{2}\ A$

$I_{ef} = \sqrt{I_2^2 + I_4^2} = \sqrt{4 + 2} = \sqrt{6}$

$I_{ef} = 2{,}45\ A$

(13.)



$4 - I_1 \cdot 120 - I \cdot 40 = 0$

$-I_2 \cdot R_{\check{Z}} - I_2 \cdot 45 + I_1 \cdot 120 = 0$

$I_1 + I_2 = I$

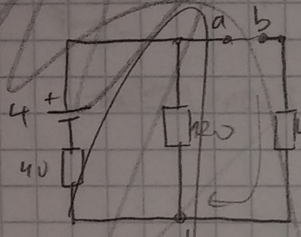
$I_2 = I - I_1$

$4 - 120 I_1 - 40 I - I_2 R_{\check{Z}} - 45 I_2 + 120 I_1 = 0$

$4 - 40 I - I R_{\check{Z}} - I_1 R_{\check{Z}} - 45 I + 45 I_1 = 0$

$-85 I - 45 I_1 - I R_{\check{Z}} - I_1 R_{\check{Z}} + 4 = 0$

THEVENIN

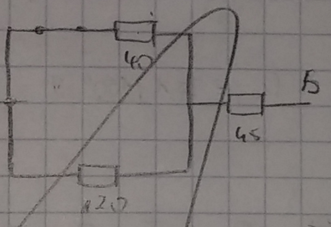


$I = \frac{4}{100} = 0{,}04\ A$

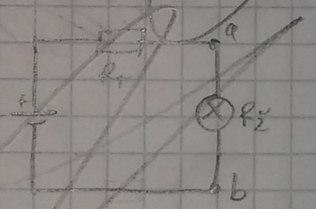
$U_a = 4\ V$

$U_b = U_a - I \cdot 120 = 1\ V$

$U_T = U_a - U_b = 3\ V$



$R_T = [120 \parallel 40] + 45 = 75\ \Omega$

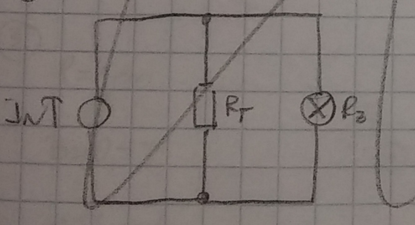


$U_{R_{\check{Z}}} = 3 \cdot \frac{R_{\check{Z}}}{75 + R_{\check{Z}}}$

$I_{R_{\check{Z}}} = I = \frac{U_T}{R_{\check{Z}} + 75} = \frac{3}{R_{\check{Z}} + 75}$

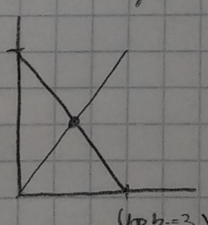
$R_{\check{Z}} = \frac{U_{R_{\check{Z}}}}{I_{R_{\check{Z}}}} = \frac{\frac{3 R_{\check{Z}}}{75 + R_{\check{Z}}}}{\frac{3}{75 + R_{\check{Z}}}}$

MORE I VAŽO JEDNA GA



$I_N = \frac{U_T}{R_T} = 0{,}04\ A$

$I_{R_{\check{Z}}} = I_N \cdot \frac{75}{R_T + R_{\check{Z}}}$



TREBA NAPRAVIT U-I DIJAGRAM IZVORA I PRESJEK PRAVCA IZVORA I PRAVCA ŽARULJE JE RADNA TOČKA

1) $R_{UK} = (45 \parallel 120) + 40 = 72{,}73\ \Omega$

$I_{UK} = \frac{4}{R_{UK}} = 0{,}055\ A$

$I_{\check{Z}} = I_{UK} \cdot \frac{120}{165} = 0{,}04\ A$

$U_{\check{Z}} = 1{,}8\ V \Rightarrow R_{\check{Z}} = \frac{U_{\check{Z}}}{I_{\check{Z}}} = 45\ \Omega$

2) $R_{UK} = 40 + 90 \parallel 120 = 91{,}43\ \Omega$

$I_{UK} = 0{,}04375\ A$

$I_{\check{Z}} = I_{UK} \cdot \frac{120}{210} = 0{,}025\ A$

$U_{\check{Z}} \approx 0{,}8\ V$

JESENSKI ROK 20

(20.)

$U_f = 381\,V$

$R_1 = 100\,\Omega$

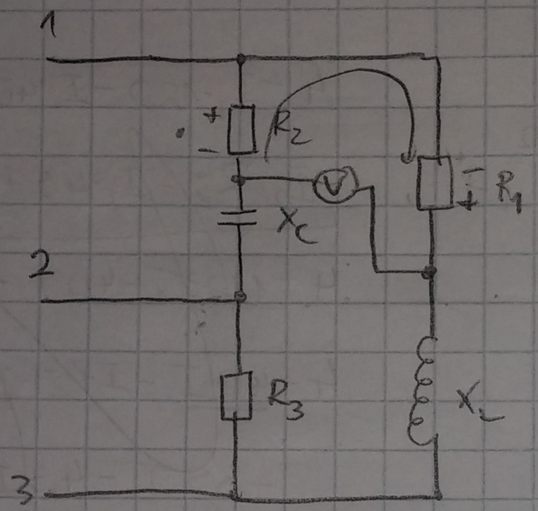
$R_2 = 200\,\Omega$

$R_3 = 300\,\Omega$

$X_L = 100\,\Omega$

$\underline{X_C = 200\,\Omega}$

$U_V = ?$



$U_f = 220\,V$

$U_{12} = 381 \angle 30°\ V$

$I_{12} = \frac{U_{12}}{200 - j200} = 1,3472 \angle 75°\ A$

$U_{31} = 381 \angle 150°\ V$

$I_{31} = \frac{U_{31}}{100 j100} = 2,6944 \angle 105°\ A$

$I_{12} \cdot R_2 + I_{31} \cdot R_1 = U_V$

$U_V = 269,44 \angle 75° + 269,44 \angle 105°$

$U_V = 520,52\,V$

(1.)

$E = 10\,MV/m$

$X_A = 0\,cm$

$X_B = 2\,cm$

$X_C = 5\,cm$

$\underline{Q_0 = -100\,pAs}$

$B \to C$

$C \to A$

(2.)

$S = 20\,cm^2 =$

$d = 95\,mm$

$|X| =$