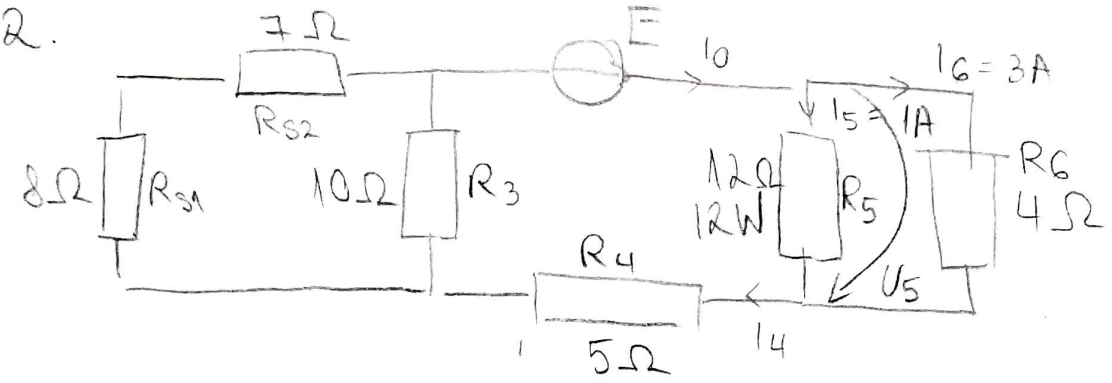
CTI-EN 3.1. EXAM EEI

2.



$R_S = R_{S1} + R_{S2} = 15\,\Omega$

$P_{R5} = I_5 \cdot U_5 = I_5^2 \cdot R_5 \Rightarrow I_5^2 = \frac{P_{R5}}{R_5} = \frac{12}{12} = 1A$

$\Rightarrow I_5 = 1A$

$U_5 = \frac{P_{R5}}{I_5} = 12V$

KCL: $I_0 = I_5 + I_6 = 4A$

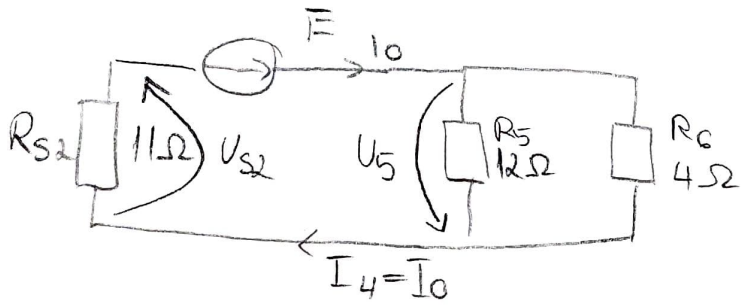
KCL: $I_4 = I_5 + I_6 = 4A$

$I_6 = \frac{U_5}{R_6} = 3A$

$R_P = R_S \parallel R_3 = \frac{R_S \cdot R_3}{R_S + R_3} = \frac{15 \cdot 10}{15+10} = \frac{150}{25} = 6\,\Omega$

$R_{S2} = R_4 + R_P = 11\,\Omega$

$\Rightarrow$

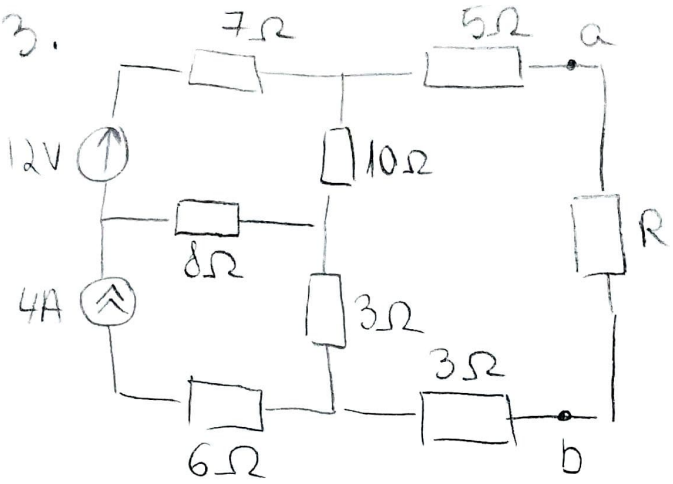


$U_{S2} = R_{S2} \cdot I_0 = 4 \cdot 11 = 44V$

KVL: $E = U_{S2} + U_5 = 56V$

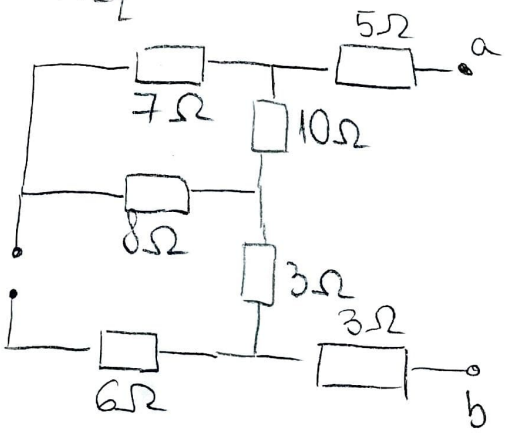
Tatu Bogdan 3.1

3.

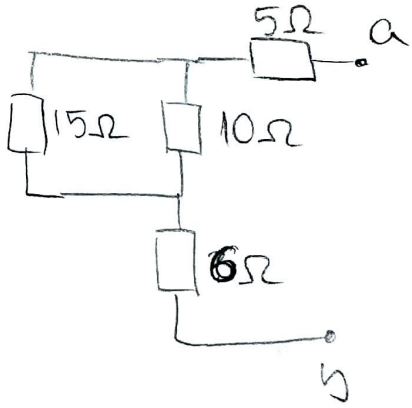


Apply Thevenin for a and b

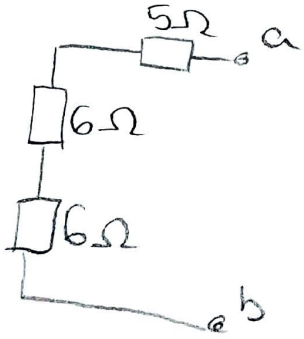
To get Req:



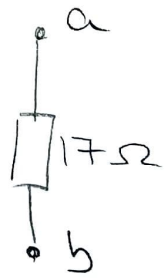
$\Leftrightarrow$



$\Leftrightarrow$



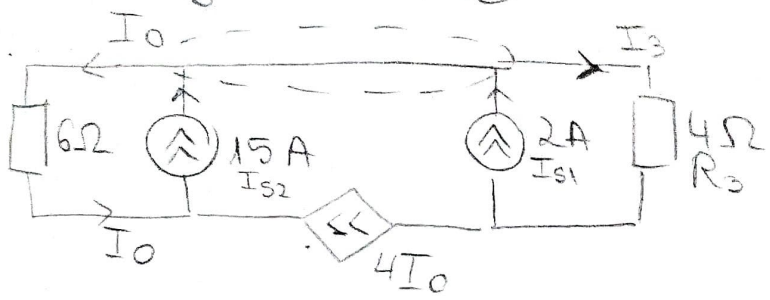
$\Leftrightarrow$



$$R^*_{max\,P} = R_{eq} = 17\,\Omega$$

Tatu Bogdan 3.1

4.



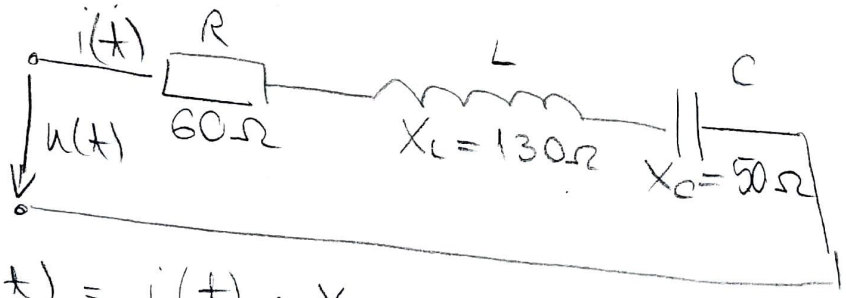
KCL: $I_0 = I_{S2} + I_{S1} - I_3 \Rightarrow I_3 = I_{S2} + I_{S1} - I_0$

$I_{S2} = I_0 + 4I_0 = 5I_0 \Rightarrow I_0 = 3A$

$\Rightarrow I_3 = 15 + 2 - 3 = 14\ A$

$U_g = U_{R_3} = I_3 \cdot R_3 = 14 \cdot 4 = 56V$

5.



$u(t) = 200\sin(314t + 70°)$

$U_L(t) = i(t) \cdot X_L$

$\underline{Z} = R + jX_L - jX_C = 60 + j(130 - 50) = 60 + j80$

$\underline{U} = \frac{200}{\sqrt{2}} \cdot e^{j70°}$

$= 100e^{j53°}$

$\underline{I} = \frac{\underline{U}}{\underline{Z}}$

$\underline{U_L} = \underline{I} \cdot jX_L = \frac{\underline{U}}{\underline{Z}} \cdot j130 = \frac{\frac{200}{\sqrt{2}} \cdot e^{j70°}}{100e^{j53}} \cdot j130$

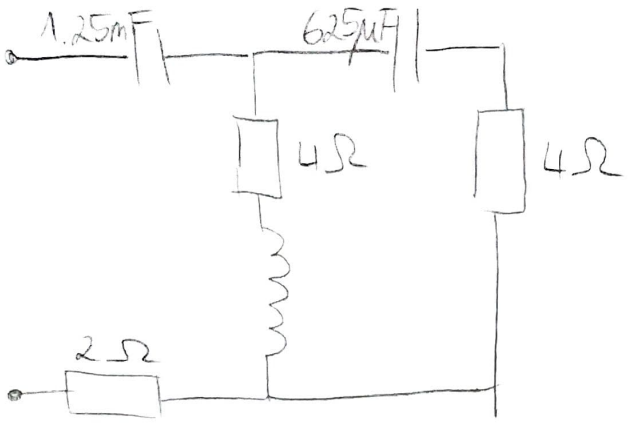
$= j\frac{260}{\sqrt{2}} e^{j17°} = \frac{260}{\sqrt{2}} e^{j107°}$

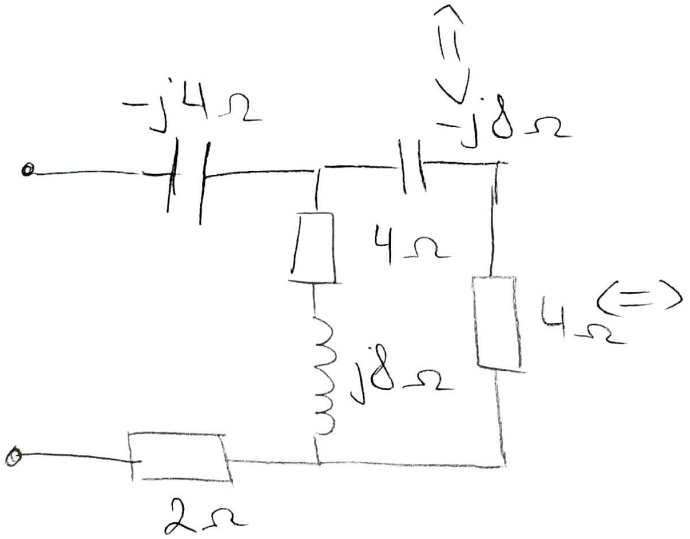
$\Rightarrow u_L(t) = 260\sin(314t + 107°)$

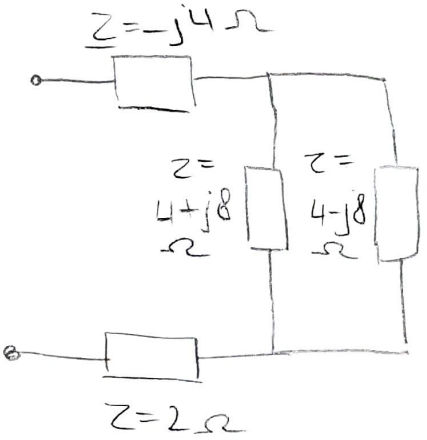
Tatu Bogdan 3.1

$\omega = 200 rad/s$

6.





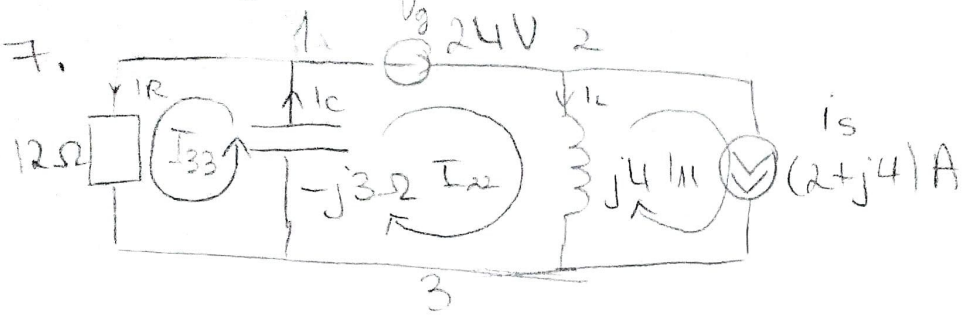


$$Z_p = \frac{(4+j8)(4-j8)}{4+j8+4-j8} = \frac{16+64}{8} = \frac{80}{8} = 10\,\Omega$$

$$Z_{eq} = 10 + 2 - j4 = 12 - j4\,\Omega$$

Tatu Bogdan 3.1

7.



$I_{11} = i_s = (2+j4)$

$I_L = -I_{11} + I_{22}$

$I_C = I_{33} + I_{22}$

$I_R = I_{33}$

KVL:

$$\begin{cases} I_{33}\cdot 12 + (I_{33}+I_{22})(-j3) = 0 \\ (I_{33}+I_{22})(-j3) + (-I_{11}+I_{22})(j4) = 24 \end{cases}$$

$$\Rightarrow \begin{cases} I_{33}(12-j3) + I_{22}(-j3) = 0 \\ I_{33}(-j3) + I_{22}(-j3+j4) - (2+j4)(j4) = 24 \end{cases}$$

$$\Rightarrow \begin{cases} I_{33}(12-j3) + I_{22}(-j3) = 0 \\ I_{33}(-j3) + I_{22}(j) = 8+8j \end{cases}$$

$$\Rightarrow I_{33} = 2j$$

$$I_{22} = 8-2j$$

$$\underline{I_L} = -I_{11} + I_{22} = -2 - j4 + 8 - 2j = 6 - 6j$$

$$\underline{U_L} = j4 \cdot \underline{I_L} = 24j + 24 = 24 + 24j$$

Tatu Bogdan 3.1

8. $u(t) = 50 + 400\sin(100\pi t - 15^\circ) + 200\sqrt{2}\sin(300\pi t + 40^\circ)$

$i(t) = 5 + 10\sin(100\pi t + 15^\circ) + 8\sqrt{2}\sin(300\pi t + 70^\circ)$

$$Q = \sum_{k=1}^{3} U_k I_k \sin\varphi_k$$

$U_1 = \frac{400}{\sqrt{2}}$ $I_1 = \frac{10}{\sqrt{2}}$ $\varphi_1 = -30^\circ$

$U_3 = \frac{200\sqrt{2}}{\sqrt{2}}$ $I_3 = \frac{8\sqrt{2}}{\sqrt{2}}$ $\varphi_3 = -30^\circ$

$$Q = \frac{400 \cdot 10}{2} \cdot \sin(-30^\circ) + 200 \cdot 8 \cdot \sin(-30^\circ)$$

$$= -\frac{1}{2} \cdot \frac{4000}{2} + \left(-\frac{1}{2}\right) \cdot 1600$$

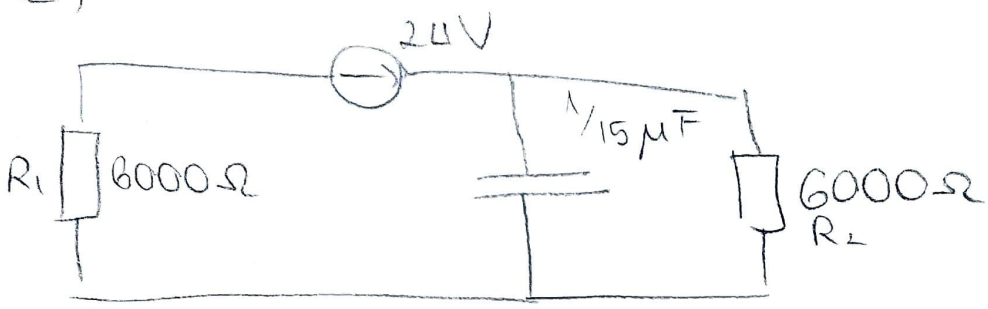
$$= -\frac{1}{2}(2000 + 1600)$$

$$= -1800 \text{ VAR}$$

Tatu Bogdan 3.1

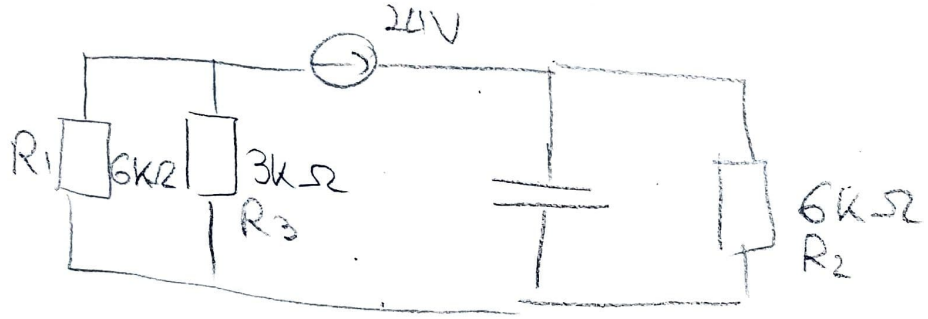
9. $u_c(t) = U_c(\infty) - [U_c(\infty) - U_c(0)]\, e^{-\frac{1}{\tau}}$

$t_0 \Rightarrow$



$$U_c(0) = \frac{R_2}{R_1+R_2} \cdot 24V = 12V$$

$t(\infty) \Rightarrow$



$$R_p = \frac{R_1 R_3}{R_1+R_3} = 2k\Omega$$

$$U_c(\infty) = \frac{R_2}{R_2+R_p} \cdot 24V = \frac{6}{8} \cdot 24 = 18V$$

$$R_{eq} = \frac{R_2 \cdot R_p}{R_2+R_p} = \frac{12}{8} = \frac{3}{2} k\Omega = 1{,}5k\Omega$$

$$\tau = R_{eq} \cdot C = \frac{3}{2} \cdot 10^3 \cdot \frac{1}{15} \cdot 10^{-6} = \frac{3}{30} \cdot 10^{-3} = 1 \cdot 10^{-4}$$

$$\Rightarrow u_c(t) = 18 - (18-12)\, e^{-\frac{1}{10^{-4}}t}$$

$$= 18 - 6\, e^{-10^4 t}$$