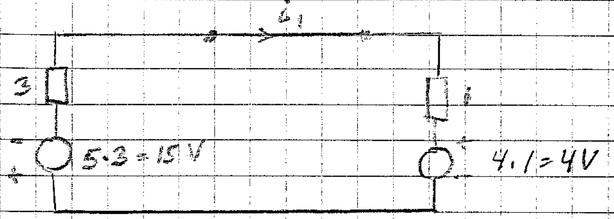
Lösningar till Elektriska kretsar o signaler del A

för D2 2003-04-26 EP

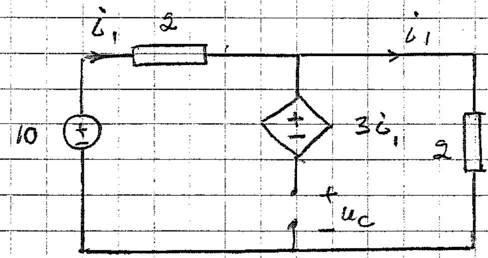
1/ $2\Omega \,//\, 2\Omega \rightarrow 1\Omega$ Gör Norton-Theveninomvandlingar



KVL $\Rightarrow +15 + 3i_1 + 1i_1 + 4 = 0$

$\Rightarrow i_1 = -\frac{19}{4} = -4{,}75\ A$

2/ $t<0$ stationär tillstånd: C utgör avbrott. Ingen ström i grenen med C. Teckna u_c!



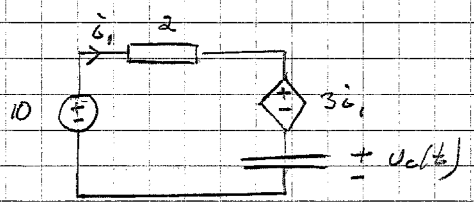
KVL stor slinga $-10 + 2i_1 + 2i_1 = 0$

$\Rightarrow i_1 = 2{,}5\ A$

KVL th $-u_c - 3i_1 + 2i_1 = 0$

$\Rightarrow u_c = -1 \cdot i_1 = -2{,}5\ V = u_c(0)$

$t \geq 0$



KVL $-10 + 2i_1 + 3i_1 + u_c(t) = 0$ (1)

$i_1 = C\frac{du_c}{dt}$ (2)

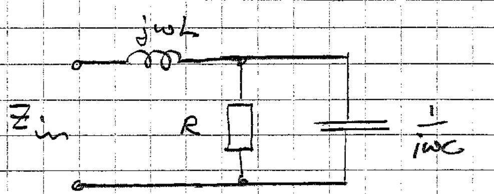
(2) i (1) $\Rightarrow \frac{du_c}{dt} + \frac{1}{5C}u_c(t) = \frac{10}{5C}$

$C = 0{,}2 \Rightarrow \frac{du_c}{dt} + u_c(t) = 10$ (3) med lösning $u_c(t) = k_1 + k_2 e^{-t/1}$ (4)

ins av (4) i (3) $\Rightarrow k_1 = 10$; $u_c(0) = k_1 + k_2 = -2{,}5 \Rightarrow k_2 = -12{,}5$

dvs $u_c(t) = 10 - 12{,}5e^{-t}$ V [koll $t \to \infty$: $i_1 \to 0$ $u_c \to 10V$ ok]

3/



$R // \frac{1}{j\omega C} = \frac{R}{1 + j\omega RC}$

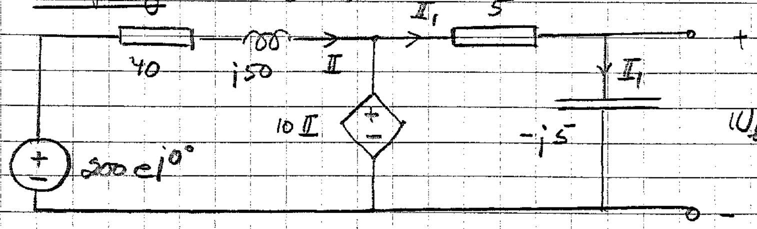
$Z_{in} = j\omega L + \frac{R}{1 + j\omega RC} = j\omega L + \frac{R(1 - j\omega RC)}{1 + \omega^2 R^2 C^2}$

Z_{in} är reell för $\omega L = \frac{\omega R^2 C}{1 + \omega^2 R^2 C^2}$

1) $\omega_r = 0 \Rightarrow Z_{in}(\omega = 0) = R = 100\ \Omega$

2) $\omega_r^2 = \frac{1}{LC} - \frac{1}{R^2C^2}$; $\Rightarrow \omega_r = 3 \cdot 10^5$ rad/s $\rightarrow Z_{in}(\omega_r) = \frac{L}{RC} = 64\ \Omega$

4/a <u>Tomgång</u> : $u_t = ?$



KVL t v

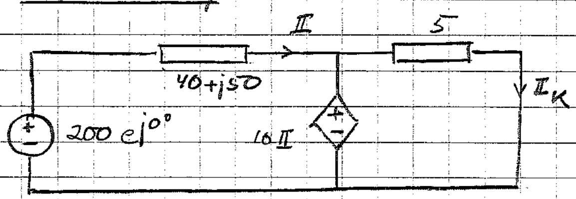
$$-200 + (40+j50)I + 10I = 0$$

$$\Rightarrow I = \frac{200}{50(1+j)} = \frac{4}{1+j}$$

KVL t h $\quad -10I + 5I_1 - j5I_1 = 0 \quad \Rightarrow I_1 = \frac{10I}{5(1-j)} = \frac{2I}{1-j} = \dots = 4$

$$\Rightarrow u_t = -j5\,I_1 = \underline{\underline{-j20}}$$

<u>Kortslutning</u>



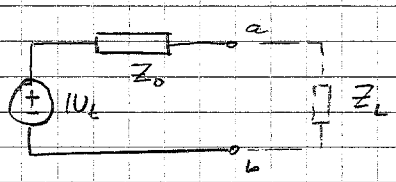
KVL t v : $-200 + (40+j50)I + 10I = 0$

$$\Rightarrow I = \frac{4}{1+j}$$

KVL t h : $-10I + 5I_K = 0$

$$\Rightarrow I_K = 2I = \frac{8}{1+j}$$

$$\Rightarrow Z_0 = \frac{u_t}{I_K} = \frac{-j20}{8}(1+j) = 2{,}5(1-j)$$



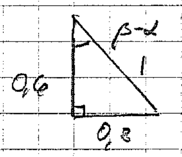
b) Effekten i Z_L är max för

$$\underline{\underline{Z_L}} = Z_0^* = \underline{\underline{2{,}5(1+j)}} \;\Omega$$

5/ Komplex effekt i de tre belastningarna :

$$S_1 = P_1 + jQ_1 = 3\cdot10^3 + j\,4\cdot10^3, \qquad S_3 = P_3 = 1{,}5\cdot10^3$$

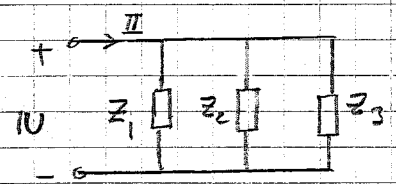
$$S_2 = P_2 + jQ_2 = S_2\cos(\beta-\alpha) + jS_2\sin(\beta-\alpha)$$



känt $\cos(\beta-\alpha) = 0{,}6 \Rightarrow$ ur fig $\sin(\beta-\alpha) = 0{,}8$
(induktiv last $\Rightarrow \beta-\alpha > 0$)

$$\Rightarrow S_2 = 2{,}5\cdot10^3\,(0{,}6 + j\,0{,}8) = 1{,}5\cdot10^3 + j\,2\cdot10^3$$

$$\Rightarrow \underline{\underline{S_{tot}}} = S_1 + S_2 + S_3 = \underline{\underline{6\cdot10^3 + j\,6\cdot10^3}} \quad \text{VA}$$



$$S_{tot} = \frac{1}{2}UI^* = \frac{1}{2}250\sqrt{2}\,e^{j0°}\cdot I_m e^{-j\alpha} =$$

$$= 6\cdot10^3(1+j) = 6\cdot10^3\sqrt{2}\,e^{j45°}$$

$$\Rightarrow \alpha = -45°, \quad I = 48 \text{ A}$$

(ansätt $I = I_m e^{j\alpha}$)

$$\Rightarrow \text{Impedansen } \underline{\underline{Z_{tot}}} = \frac{U}{I} = \frac{250\sqrt{2}\,e^{j0°}}{48e^{-j45°}} = 7{,}36\,e^{j45°} = \underline{\underline{5{,}21(1+j)\,\Omega}}$$