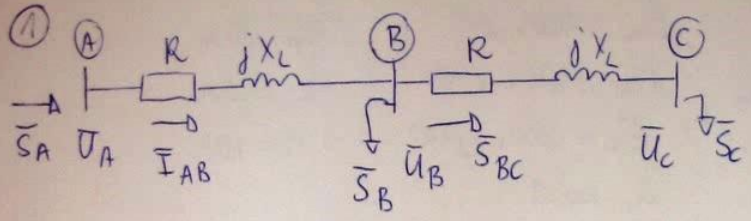
VA'R 1. ZH

$R = 5\,\Omega$, $X_L = 5\,\Omega$



$\bar{S}_{BC} = 1732\,kW$ (3f)

$\bar{S}_B = 1732\,kVA$ (3f)

$\cos\varphi = 0{,}8$

$U_B = 20\angle 0°\ kV$ vonali

(20 kV névleges feszültségű távvezeték pozitív sorrendű R és X adatokkal)

Meghatározandó:

1.) $(|\bar{U}_A| - |\bar{U}_C|)$ / névleges % -ban

2.) A átvitel vesztesége: P_v és Q_v (3f értékek)

3.) Fazorábra: $\bar{U}_A, \bar{U}_B, \bar{U}_C, \bar{I}_{AB}, \bar{I}_B, \bar{I}_{BC}$

$\varphi = 36{,}87°$; $|\Delta U| \approx \Delta U_R$

(B) $S = \sqrt{3}\cdot U_B \cdot I \Rightarrow I = \frac{S_B}{\sqrt{3}\cdot U_B} = \frac{1732}{\sqrt{3}\cdot 20\angle 0°} = \underline{50A}$; $\bar{I} = \overset{50\cdot\cos\varphi}{40} - j\overset{50\cdot\sin\varphi}{30}\,A$

$\bar{S} = \bar{U}\cdot I^*\cdot\sqrt{3} \Rightarrow I = \frac{\bar{S}^*}{\sqrt{3}\cdot U^*} = \frac{\overset{1732\cdot\cos\varphi}{1385{,}6} - \overset{1732\cdot\sin\varphi}{1039{,}2}j}{\sqrt{3}\cdot 20} = 40 - j30\,A$

BC

$I_{BC} = \frac{\bar{S}_{BC}^*}{\sqrt{3}\cdot U} = \frac{1732}{\sqrt{3}\cdot 20} = \underline{50A} + j0$

$Q_{BC} = 0$

$I_{AB} = \bar{I}_B + \bar{I}_{BC} = 40 - j30\,A + 50A$

$I_{AB} = 90A - j30\,A$

$|I_{AB}| = \sqrt{90^2 + 30^2} = \underline{94{,}9\,A}$

(1) $|U_C| \cong |U_B| - |\Delta U_{BCh}| =$

$= |U_B| - |I_{Bp}\cdot R + I_{Bq}\cdot X| = \frac{20\,kV}{\sqrt{3}} - \underset{250}{50\cdot 5} = \underline{11{,}297\,kV}$

(I_{BC})

$|U_A| \cong |U_B| + |\Delta U_{ABh}| = |U_B| + I_{ABp}\cdot R + I_{ABq}\cdot X$

$= \underset{11547}{\frac{20\,kV}{\sqrt{3}}} + \underset{600}{90\cdot 5} + 30\cdot 5 = \underline{12{,}147\,kV}$

$$|\underline{U}_A| - |\underline{U}_C| = |\Delta U_{ABA}| + |\Delta U_{BCA}| = 250 + 600 = \underline{850V}$$

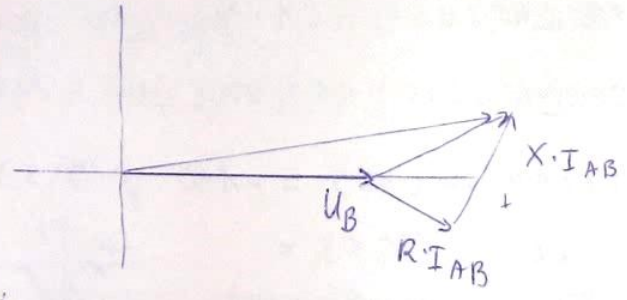
$$\frac{|\underline{U}_A| - |\underline{U}_C|}{\frac{20kV}{\sqrt{3}}} = \frac{850V \cdot \sqrt{3}}{20kV} \cdot 100\% = \underline{7,4\%}$$

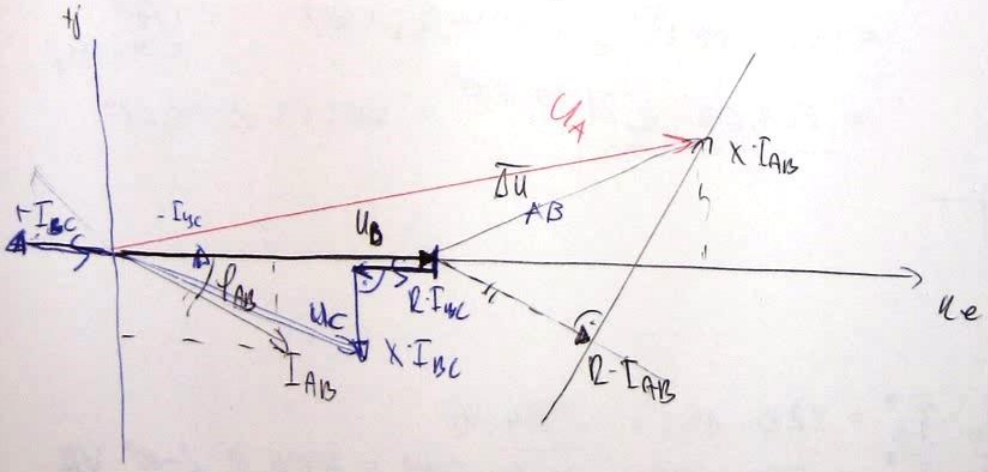
② $P_V = R\,(|I_{AB}|^2 + |I_{BC}|^2) = 5 \cdot (94,87^2 + 50^2) = 57,5\,kW$

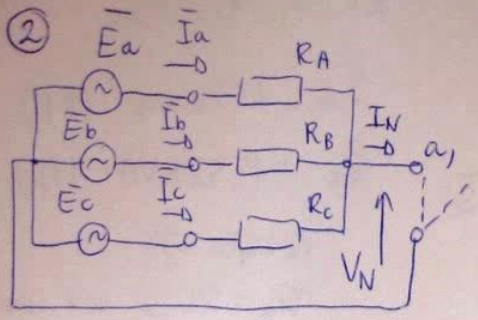
$P_{V3f} = 3 \cdot 57,5\,kW = 172,5\,kW$

$Q_V = X\,(|I_{AB}|^2 + |I_{BC}|^2) = 5\,(94,87^2 + 50^2) = 57,5\,kvar$

$Q_{3f} = 172,5\,kvar$





② 

$\bar{E}_a = 220V \angle 0°$ $\quad R_A = 20\Omega$

$\bar{E}_b = 220V \angle -120°$ $\quad R_B = 10\Omega$

$\bar{E}_c = 220V \angle +120°$ $\quad R_c = 10\Omega$

a) zárt

b) nyitott kapcsoló

Határozza meg az alábbi mennyiségeket mindkét esetre.

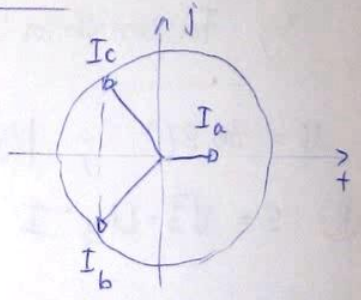
1.) $\bar{I}_a, \bar{I}_b, \bar{I}_c$ és hozzá fazorábra

2.) $\bar{S}_a, \bar{S}_b, \bar{S}_c$ $\quad (\bar{S} = P + jQ)$

3.) $\bar{S}_{3f}$

$Y_A = \frac{1}{R_A} = \frac{1}{20\Omega} = 0{,}05\,mho$

$Y_B = Y_C = \frac{1}{R_B} = \frac{1}{10\Omega} = 0{,}1\,mho$



a) 1.) Kapcsoló: zárt $\quad V_N = \emptyset$

$\bar{I}_a = Y_A \cdot \bar{E}_a = 0{,}05\,mho \cdot 220V \angle 0° = \underline{11 \angle 0°\,A}$

$\bar{I}_b = Y_B \cdot \bar{E}_b = 0{,}1 \cdot 220V \angle -120° = \underline{22 \angle -120°\,A}$

$\bar{I}_c = Y_C \cdot \bar{E}_c = 0{,}1 \cdot 220V \angle +120° = \underline{22 \angle +120°\,A}$

2.) $\bar{S}_a = \bar{U}_a \cdot \bar{I}_a^* = 220 \angle 0° \cdot 11 \angle 0° = \underline{2420 \angle 0°\,VA}$

$\bar{S}_b = \bar{U}_b \cdot \bar{I}_b^* = 220 \angle -120° \cdot 22 \cdot \angle +120° = \underline{4840 \angle 0°\,VA}$

$\bar{S}_c = \bar{U}_c \cdot \bar{I}_c^* = 220 \angle +120° \cdot 22 \angle -120° = \underline{4840 \angle 0°\,VA}$

3.) $\bar{S}_{3f} = \bar{S}_a + \bar{S}_b + \bar{S}_c = 2420 + 2 \cdot 4840 = \underline{12{,}1\,kVA}$

b) kapcsoló (CB): Nyitott, $V_N \neq \emptyset$, $I_N = \emptyset$ $\quad Y = Y_B = Y_C$

1.) $Y_A = Y + \Delta Y = 0{,}05\,\text{mho}$; $Y = 0{,}1\,\text{mho}$; $\Delta Y = -0{,}05\,\text{mho}$

$$\bar{V}_N = \frac{Y_A + a^2 Y_B + a Y_C}{Y_A + Y_B + Y_C} \cdot E_a = \frac{Y + a^2 Y_B + a Y + \Delta Y}{Y + Y + Y + \Delta Y} \cdot E_a =$$

$$= \frac{(1 + a + a^2) Y + \Delta Y}{3Y + \Delta Y} \cdot E_a = \frac{-0{,}05\,\text{mho}}{3 \cdot 0{,}1\,\text{mho} - 0{,}05\,\text{mho}} \cdot 220\,\text{V}\angle 0° =$$

$$\bar{V}_N = -44\,\text{V}$$

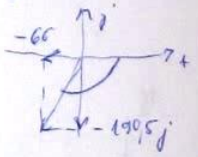
$$\bar{I}_a = Y_A (\bar{E}_a - \bar{V}_N) = 0{,}05\,(220\angle 0° + 44\angle 0°) = 0{,}05 \cdot 264 = 13{,}2\angle 0°\,\text{A}$$

$$\bar{I}_b = Y_B (\bar{E}_b - \bar{V}_N) = 0{,}1\,(220\angle -120° + 44\angle 0°) = 0{,}1 \cdot 201{,}6\angle -110° = 20{,}16\angle 110°\,\text{A}$$

$$\bar{I}_C = Y_C (\bar{E}_C - \bar{V}_N) = 0{,}1\,(220\angle +120° + 44\angle 0°) = 0{,}1 \cdot 201{,}6\angle +110° = 20{,}16\angle 110°\,\text{A}$$

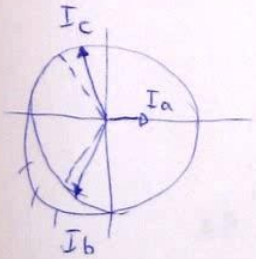
$$220 \cdot e^{-j120°} = 220° \cos(-120°) + j\,220 \cdot \sin(-120°) = -110 - j\,190{,}53$$

$$220 \cdot e^{-j120°} + 44 \cdot e^{j0°} = -66 - j\,190{,}53 =$$



$$= \sqrt{66^2 + 190{,}5^2}\; e^{-j(\arcsin \frac{66}{190{,}5} + 90°)}$$

$$= 201{,}63 \cdot e^{-j110{,}27°} = 201{,}63\angle -110{,}27°$$



2.) $\bar{S}_a = \bar{U}_a \cdot \bar{I}_a^* = 220 \cdot 13{,}2 = 2904\,\text{W}$

$\bar{S}_b = \bar{U}_b \cdot \bar{I}_b^* = 220\angle -120° \cdot 20{,}16\angle +110° = 4435{,}2\angle -10°\,\text{VA}$

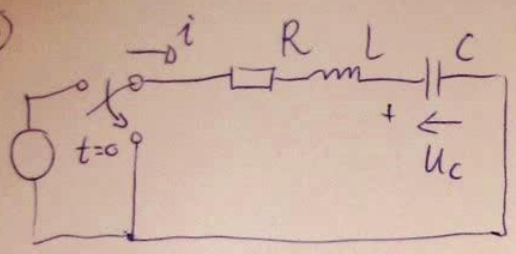
$= 4435{,}2 \cdot \cos 10° + j\,4435{,}2 \cdot \sin 10° = 4368 - 770j$

$\bar{S}_C = \bar{U}_C \cdot \bar{I}_C^* = 220\angle +120° \cdot 20{,}16\angle -110° = 4435{,}2\angle +10°\,\text{VA}$

$= 4368 + 770j$

3.) $\bar{S}_{3f} = \bar{S}_a + \bar{S}_b + \bar{S}_c = 2904 + 2 \cdot 4368 = 11640\,\text{kW}$

③



$i(-0) = 0$ $\quad u_C(-0) = 200V$

$C = 10\mu F$ $\quad L = 500\,mH$

R : a) $R = R_a = 448\,\Omega$

b) $R = R_b = 4{,}48\,\Omega$

Adja meg a) és b) esetekre:

1.) Rezgés jellemzői (körfrekvencia, csillapítási tényező)

2.) Az $i(t)$ és $u_C(t)$ időfv. $t \geq 0$ -ra

3.) Ellenálláson hővé alakuló energia?

1.)

a) $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{500mH \cdot 10\mu F}} = 447{,}2\ \frac{1}{s}$

$\alpha = \frac{R}{2L} = \frac{448\,\Omega}{2 \cdot 50mH} = 448\ \frac{1}{s}$

$\alpha > \omega_0$ aperiódikus

$R > 2 \cdot R_0 = 2 \cdot \sqrt{\frac{L}{C}}$ (L. 2.)

2 fele feltétel!

b) $\omega_0 = \frac{1}{\sqrt{LC}} = 447{,}2\ \frac{1}{s}$

$\alpha = \frac{R}{2L} = 4{,}48\ \frac{1}{s}$

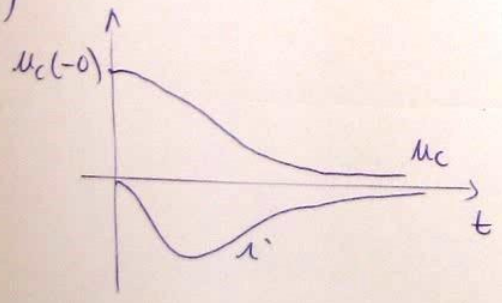
$\alpha < \omega_0$ periódikus

$R_{krit} = 2R_0$

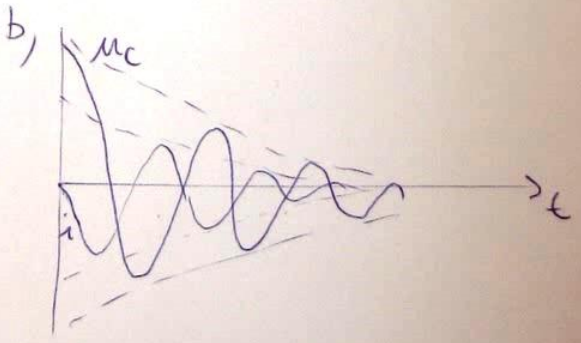
aperiódikus, ha $R \geq R_{krit}$

2.)

a) i



b)



3.) Kondenzátor energiája: $W_C = \frac{1}{2} C \cdot U^2 = \frac{1}{2} 10 \cdot 10^{-6} \cdot 200^2 = 0{,}2\,J$

$W_R = W_C = 0{,}2\,J$

A kondenzátor energiája az ellenálláson alakul hővé.