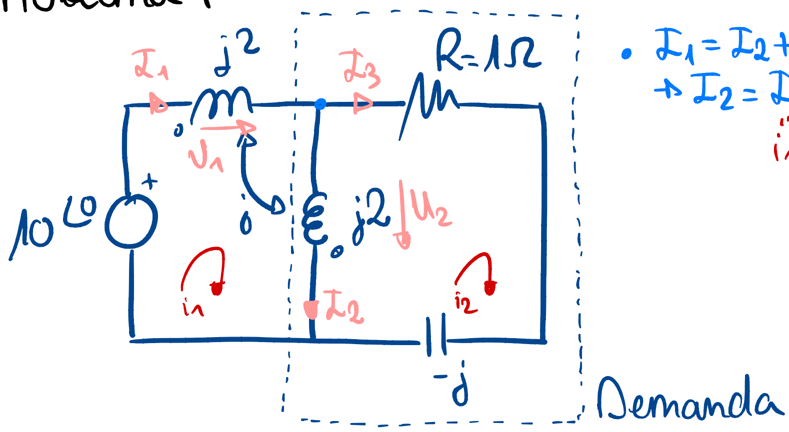
Bobina tensión intensidad mismo sentido

m1) $(2j+2j-2j)I_1+(-2j+j)I_3=10$
m2) $(-2j+j)I_1+2jI_3+(1-j)I_3=0$

Problema 1



- $I_1=I_2+I_3$
- $\rightarrow I_2=I_1-I_3$
  $i_1 \quad i_2$

a) P,Q generada o consumida en la Demanda
b) P,Q generada o consumida en la fuente
c) Analizar resultados
d) P,Q generada o consumida por todos los elementos

Poniendo mismo sentido tensión e intensidad

$U_1=j2I_1-jI_2$
$U_2=j2I_2-jI_1$

i_1: $\left.\begin{array}{l} 10\angle 0=U_1+U_2=j2I_1-jI_2+j2I_2-jI_1=jI_1+jI_2 \\ I_2=I_1-I_3\end{array}\right\} 10\angle 0=jI_1+j(I_1-I_3)\rightarrow$

$\rightarrow 10\angle 0=j2I_1-jI_3$

i_2: $\left.\begin{array}{l} 0=(1-j)I_3-U_2=(1-j)I_3-(j2I_2-jI_1) \\ I_2=I_1-I_3\end{array}\right\} 0=(1-j)I_3-j2(I_1-I_3)+jI_1\rightarrow$

$\rightarrow 0=I_3-jI_3-j2I_1+j2I_3+jI_1=-jI_1+(1+j)I_3$

i_1: $I_1=\dfrac{\begin{vmatrix}10\angle 0 & -j\\ 0 & 1+j\end{vmatrix}}{\begin{vmatrix}j2 & -j\\ -j & 1+j\end{vmatrix}}=\dfrac{10\angle 0(1+j)}{j2(1+j)+1}=\dfrac{10(1+j)}{j2-2+1}=\dfrac{10(1+j)}{j2-1}=\dfrac{10(1+j)(-1-j2)}{(-1+j2)(-1-j2)}=$

$=\dfrac{10(-1-j2-j+2)}{1+4}=\dfrac{10(1-j3)}{5}=2(1-j3)$

i_2: $I_3=\dfrac{\begin{vmatrix}j2 & 10\angle 0\\ -j & 0\end{vmatrix}}{\begin{vmatrix}j2 & -j\\ -j & 1+j\end{vmatrix}}=\dfrac{10\angle 0 j}{j2(1+j)+1}=\dfrac{10j}{j2-2+1}=\dfrac{j10}{j2-1}=\dfrac{j10(-1-j2)}{(-1+j2)(-1-j2)}=$

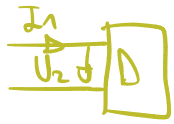
$=\dfrac{10(2-j)}{1+4}=\dfrac{10(2-j)}{5}=2(2-j)$

$I_2 = I_1 - I_3 = 2(1-j3) - 2(2-j) = 2(-1-j2) = -2(1+j2)$

a) P,Q generada o consumida en la Demanda

$U_2 = j2 I_2 - j I_1 = j2(-2(1+j2)) - j(2(1-j3)) = j2(-2-j4-1+j3) = j2(-3-j) =$

$= 2(-j3+1) = 2(1-j3)$



Por lo que la potencia en Demanda es:

$S_{dem} = U_2 \cdot I_1^* = 2(1-j3)\,2(1+j3) = 4(1+9) = 4 \cdot 10 = 40 \text{ VA}$ $\rightarrow P = 40 \text{ W}$, $\rightarrow Q = 0 \text{ VAr}$

Consume potencia activa (40W) y no consume ni genera reactiva

b) P,Q generada o consumida en la fuente

$S_g = 10\angle 0 \cdot I_1^* = 10 \cdot 2(1+j3) = 20(1+j3) = 20 + j60 \text{ VA}$ $\rightarrow P = 20 \text{ W}$, $\rightarrow Q = 60 \text{ VAr}$

Genera potencia activa (20W) y reactiva (60 VAr)

c) Analizar resultados

La fuente genera 20 W, sin embargo, en demanda, se consumen 40 W

d) P,Q generada o consumida por todos los elementos

$I_3 = 2(2-j) = 4-j2 = \sqrt{4^2+2^2} = \sqrt{16+4} = \sqrt{20} = 2\sqrt{5}$

$P_R = R\, I_3^2 = 1 \cdot (2\sqrt{5})^2 = 4 \cdot 5 = 20 \text{ W}$

$Q_c = Z_c\, I_3^2 = -1\,(2\sqrt{5})^2 = -4 \cdot 5 = -20 \text{ VAr}$

Comprobamos

$S_{dem,I_2} = U_2 I_2^* = 2(1-j3)(-2(1-j2)) = -4(1-j2-j3-6) = -4(-5-j5) = 20(1-j)$

$= 20 - j20 \text{ VA}$ $\rightarrow P = 20 \text{ W}$, $\rightarrow Q = -20 \text{ VAr}$

$$U_1 = j2 I_1 - j I_2 = j2\cdot 2(1-j3) + j2(1+j2) = 2(j2+6+j-2) = 2(4+j3)$$

$$S_{dem,l_1} = U_1 I_1^* = 2(4+j3)\cdot 2(1+j3) = 4(4+j12+j3-9) = 4(-5+j15) = 20(-1+j3) =$$

$$= -20 + j60 \text{ VA} \begin{cases} \rightarrow P = -20\text{W} \\ \rightarrow Q = 60\text{VAr} \end{cases}$$

Comparando

$S_{dem,l_1} = -20\text{W} + 60 \text{ VAr}$

$S_{dem,l_2} = 20\text{W} - 20\text{VAr}$

Entonces, tenemos:

Saliente

$S_g = 20 + j60$ VA

Entrante

$S_{dem,L_2} = 20 + j20$ VA

$S_{dem,L_1} = -20 + j60$ VA

$S_R = 20$ W

$S_C = -j20$ VAr

Por lo tanto

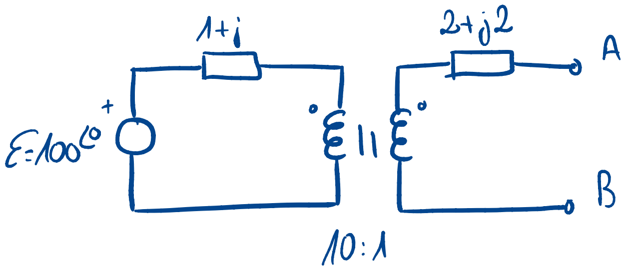
Potencia activa:

- Se generan 20 W en la fuente
- Se transfieren 20 W de la bobina 1 a la 2. (en el conjunto, la potencia activa es 0 W)
- Se consumen 20 W en la resistencia

Potencia reactiva:

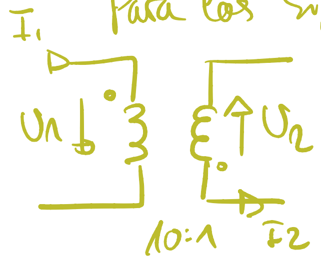
- Se generan 60 VAr en la fuente y 20 VAr en el condensador
- Se consumen 60 VAr en la bobina 1 y 20 VAr en la bobina 2

Problema 2



Thevenin
Norton

Para los signos

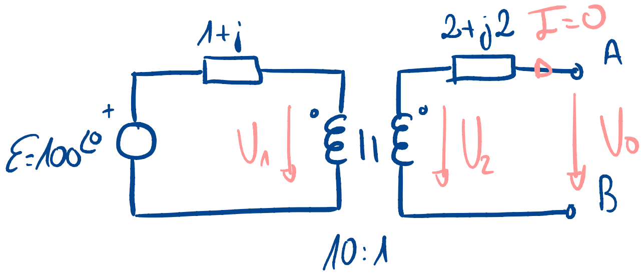


$\frac{U_1}{U_2} = 10$

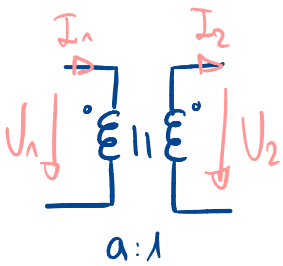
$\frac{I_1}{I_2} = \frac{1}{10}$

U sale pto
I → 1 entra
otra sale
por lado
pto.

Tensión a circuito abierto



Sabiendo que:



- Tensiones transformador $\frac{U_1}{U_2} = a$
- Potencias transformador $U_1 I_1^* = U_2 I_2^*$

$$\left.\right\} \frac{U_1}{U_2} = \frac{I_2^*}{I_1^*} = a \rightarrow$$

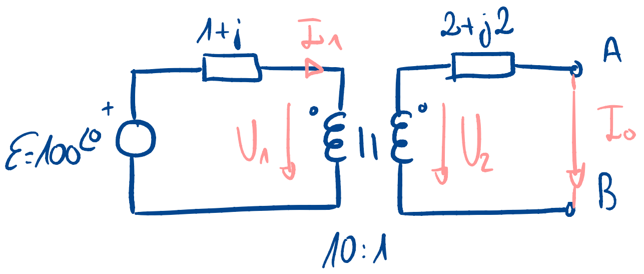
$$\rightarrow \frac{I_1}{I_2} = \left(\frac{1}{a}\right)^*$$

Podemos concluir:

$I_2 = 0 \rightarrow I_1 = 0$

$U_1 = E = 100\angle 0 \rightarrow U_2 = \frac{U_1}{a} = \frac{100}{10}\angle 0 = 10\angle 0 \rightarrow U_0 = 10\angle 0$

Intensidad de cortocircuito



$$\mathcal{E}=(1+j)I_1+U_1 \to 100^{\angle 0}=(1+j)I_1+U_1 \to U_1=100^{\angle 0}-(1+j)I_1$$

$$U_1=10U_2 \to U_2=\frac{U_1}{10}=\frac{100^{\angle 0}-(1+j)I_1}{10}$$

$$U_2=I_0(2+j2)$$

$$\left.\right\} I_0(2+j2)=\frac{100^{\angle 0}-(1+j)I_1}{10}$$

$$\frac{I_1}{I_0}=\left(\frac{1}{a}\right)^* \to \frac{I_1}{I_0}=\left(\frac{1}{10}\right)^*=\frac{1}{10} \to I_1=\frac{I_0}{10}$$

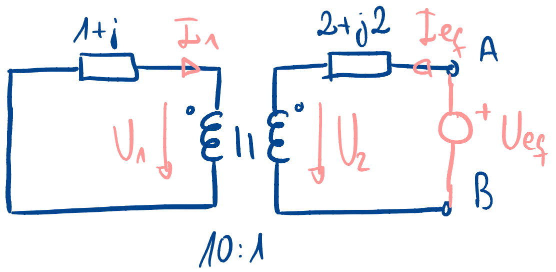
$$\to I_0(2+j2)=\frac{100^{\angle 0}-(1+j)\frac{I_0}{10}}{10} \to 100\,I_0(2+j2)=1000-(1+j)I_0 \to$$

$$\to 201(1+j)I_0=1000 \to I_0=\frac{1000}{201(1+j)}=\frac{1000\cdot(1-j)}{201(1+j)\cdot(1-j)}=\frac{1000(1-j)}{201(1+1)}=$$

$$=\frac{500(1-j)}{201}$$

Impedancia equivalente

$$Z_{eq}=\frac{U_0}{I_0}=\frac{10}{\frac{500(1-j)}{201}}=\frac{201}{50(1-j)}=\frac{201(1+j)}{50(1-j)(1+j)}=\frac{201(1+j)}{100}$$



$$0=(1+j)I_1+U_1 \rightarrow U_1=-(1+j)I_1$$

$$U_1=10U_2$$

$$10U_2=-(1+j)I_1 \rightarrow U_2=\frac{-(1+j)I_1}{10}$$

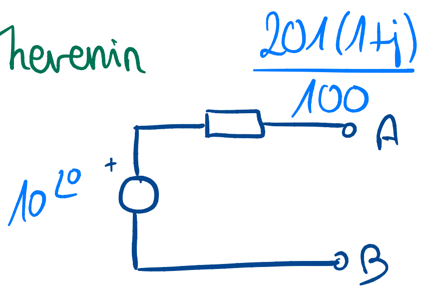
$$U_{ef}=I_{ef}(2+j2)+U_2$$

$$\rightarrow U_{ef}=I_{ef}(2+j2)-\frac{(1+j)I_1}{10}$$

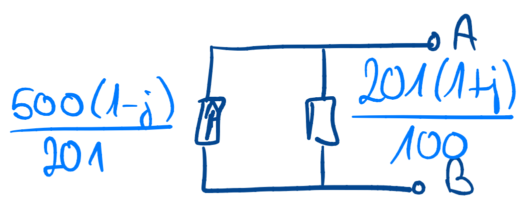
$$\frac{I_1}{-I_{ef}}=\left(\frac{1}{a}\right)^* \rightarrow \frac{I_1}{-I_{ef}}=\left(\frac{1}{10}\right)^*=\frac{1}{10} \rightarrow I_1=\frac{-I_{ef}}{10}$$

$$U_{ef}=I_{ef}(2+j2)+\frac{(1+j)I_{ef}}{100} \xrightarrow{Z_{ef}} \frac{U_{ef}}{I_{ef}}=\frac{200(1+j)+(1+j)}{100}=\frac{201(1+j)}{100}$$

Thevenin



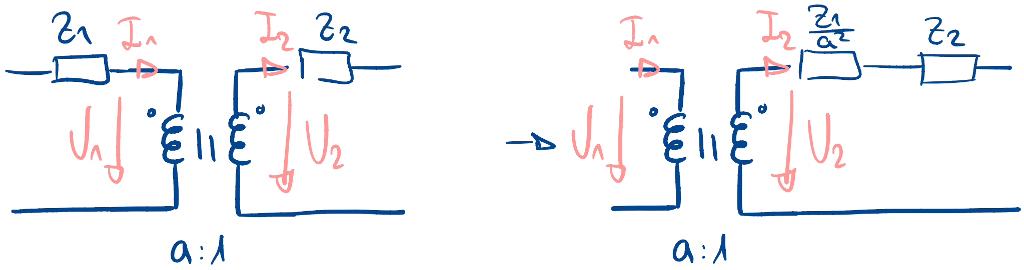
Norton



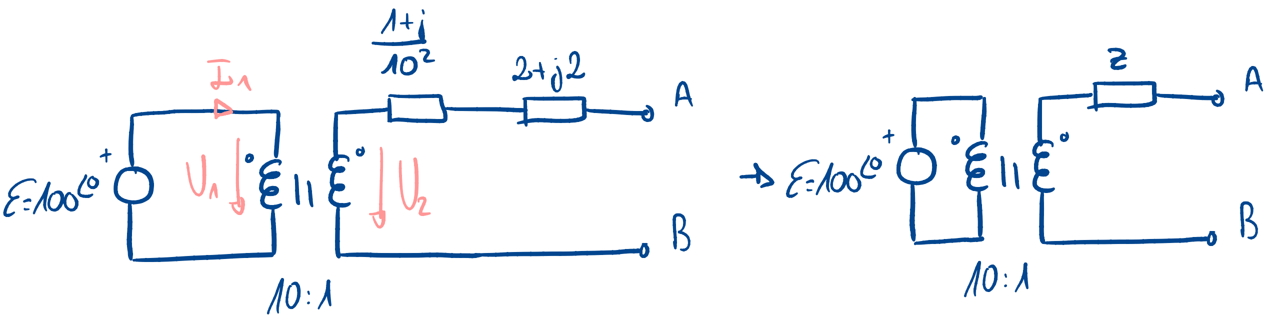
Ya que

$$\left.\begin{array}{l} U_1 I_1^* = U_2 I_2^* \\ U = IR \end{array}\right\} I_1^2 R_1 = I_2^2 R_2 \rightarrow \frac{I_1^2}{I_2^2} = \frac{R_2}{R_1}$$

$$\left.\begin{array}{l} \frac{I_1^2}{I_2^2} = \frac{R_2}{R_1} \\ \frac{I_1}{I_2} = \left(\frac{1}{a}\right)^* \end{array}\right\} \frac{R_2}{R_1} = \left(\frac{1}{a}\right)^2 \rightarrow R_2 = \frac{R_1}{a^2}$$

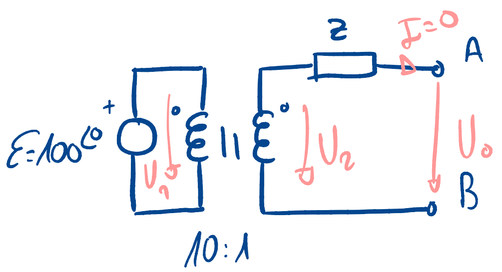


Entonces, tenemos:



$$z = \frac{1+j}{10^2} + 2+j2 = \frac{1+j+200(1+j)}{100} = \frac{201(1+j)}{100}$$

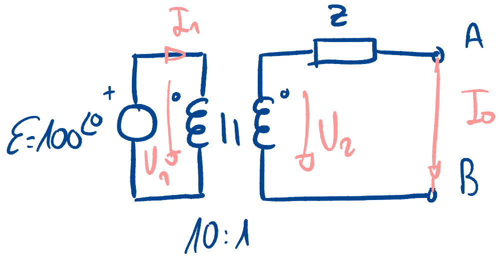
Tensión a circuito abierto:



$$\left.\begin{array}{l} \mathcal{E} = U_1 \\ U_1 = 10U_2 \\ U_2 = U_0 \end{array}\right\} U_0 = \frac{\mathcal{E}}{10} = 10\angle 0$$

Corriente de cortocircuito:

$$U_0 = I_0 R_{eq} \rightarrow I_0 = \frac{U_0}{R_{eq}} = \frac{10^{\angle 0}}{\frac{201(1+j)}{100}} = \frac{500(1-j)}{201}$$



$$\left.\begin{aligned} \mathcal{E} &= U_1 \\ U_1 &= 10U_2 \\ U_2 &= I_0 Z \end{aligned}\right\} \mathcal{E} = 10 I_0 Z \rightarrow I_0 = \frac{\mathcal{E}}{10Z} = \frac{100^{\angle 0}}{10\,\frac{201(1+j)}{100}} = \frac{500(1-j)}{201}$$