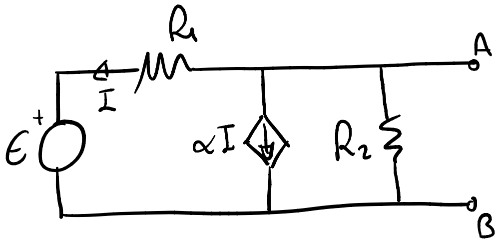
Ejercicio 1.

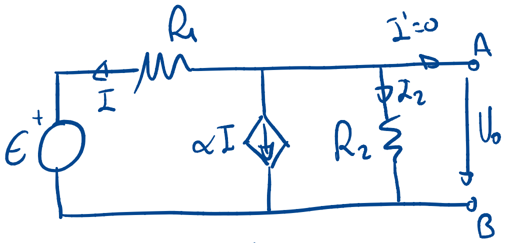


$\mathcal{E} = 3V \quad R_2 = 2\Omega$

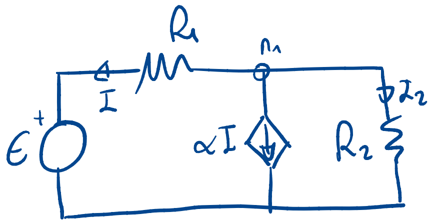
$R_1 = 3\Omega \quad \alpha = 2$

Thevenin
Norton

- Tensión a circuito abierto

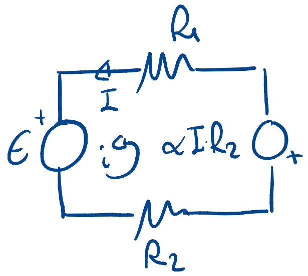


$U_0 = I_2 R_2$



$n: \; I + \alpha I + I_2 = 0 \rightarrow I_2 = -\alpha I - I = -I(1+\alpha)$

Fuente intensidad paralelo con resistencia → fuente tensión serie con resistencia



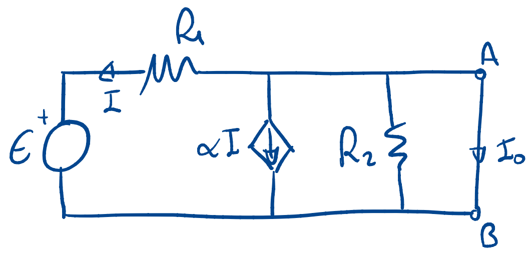
$i \circlearrowright \; -\mathcal{E} - \alpha I R_2 = i(R_1 + R_2) \xrightarrow{i=I} -\mathcal{E} = I(R_1 + R_2(1+\alpha)) \rightarrow$

$\rightarrow I = \dfrac{-\mathcal{E}}{R_1 + R_2(1+\alpha)} = \dfrac{-3}{3+2(1+2)} = \dfrac{-3}{3+2\cdot 3} = \dfrac{-1}{1+2} = \dfrac{-1}{3} \; A$

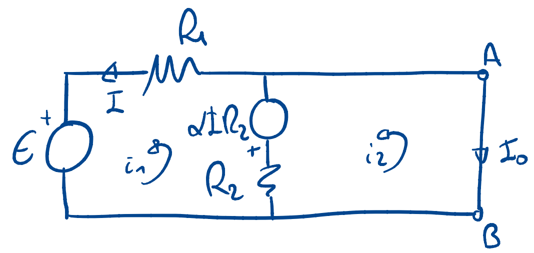
$n: \; I_2 = -I(1+\alpha) = -\dfrac{-1}{3}(1+2) = 1 \; A$

$U_0 = I_2 R_2 = 1 \cdot 2 = 2 \; V$

- Intensidad de cortocircuito



Fuente intensidad paralelo con resistencia → fuente tensión serie con resistencia



$i_1 \circlearrowright \; -\mathcal{E} - \alpha I R_2 = i_1(R_1+R_2) - i_2 R_2 \xrightarrow{i_1 = I}$

$\rightarrow -\mathcal{E} = I(R_1 + R_2(1+\alpha)) - i_2 R_2$

$i_2 \circlearrowright \; \alpha I R_2 = i_2 R_2 - i_1 R_2 \xrightarrow{i_1 = I} 0 = -I R_2(1+\alpha) + i_2 R_2$

$$\hat{e} = Z_m \hat{i} \rightarrow \begin{pmatrix} -\mathcal{E} \\ 0 \end{pmatrix} = \begin{pmatrix} R_1 + R_2(1+\alpha) & -R_2 \\ -R_2(1+\alpha) & R_2 \end{pmatrix} \begin{pmatrix} I \\ i_2 \end{pmatrix} \rightarrow \begin{pmatrix} -3 \\ 0 \end{pmatrix} = \begin{pmatrix} 9 & -2 \\ -6 & 2 \end{pmatrix} \begin{pmatrix} I \\ i_2 \end{pmatrix}$$

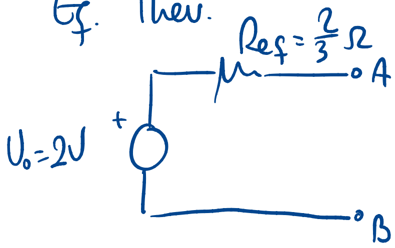
$$i_2 = \frac{\begin{vmatrix} 9 & -3 \\ -6 & 0 \end{vmatrix}}{\begin{vmatrix} 9 & -2 \\ -6 & 2 \end{vmatrix}} = \frac{-18}{18-12} = \frac{-3}{3-2} = \frac{-3}{1} = -3 \text{ A}$$

$I_o = -i_2 = 3A$

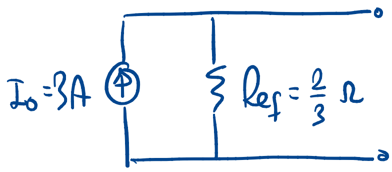
- Resistencia equivalente

$U_o = I_o R_{eq} \rightarrow R_{eq} = \frac{U_o}{I_o} = \frac{2}{3} \, \Omega$

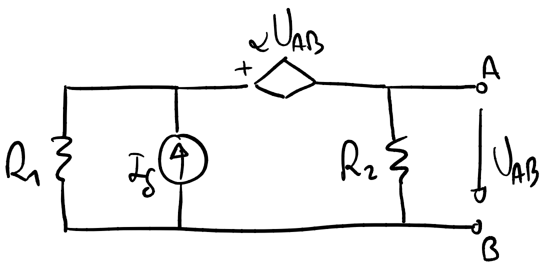
Eq. Thev.



Eq. Norton



Ejercicio 2.

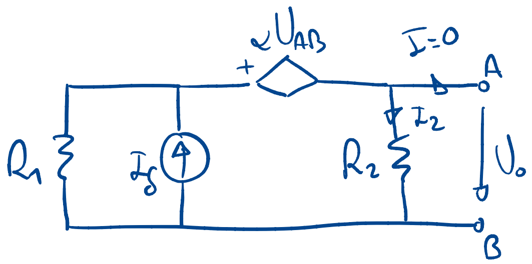


$I_g = 10\,A$ $\quad R_2 = 2\,\Omega$

$R_1 = 6\,\Omega$ $\quad \alpha = 2$

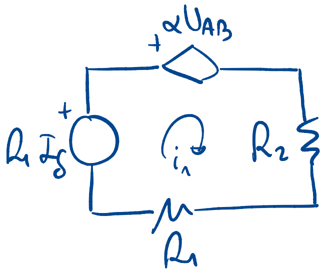
Norton

- Tensión de cortocircuito



$$U_{AB} = U_0 = I_2 \cdot R_2$$

Fuente intensidad paralelo con resistencia → fuente tensión serie con resistencia



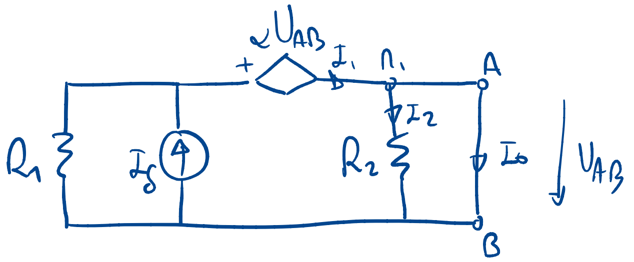
$U_{AB} = I_2 R_2 = i_1 R_2$

i_1: $R_1 I_g - \alpha U_{AB} = i_1(R_1 + R_2) \rightarrow R_1 I_g = i_1(R_1 + R_2(1+\alpha))$

$$\rightarrow i_1 = \frac{R_1 I_g}{R_1 + R_2(1+\alpha)} = \frac{6 \cdot 10}{6 + 2(1+2)} = \frac{60}{12} = 5\,A$$

$$U_0 = i_1 \cdot R_2 = 5 \cdot 2 = 10\,V$$

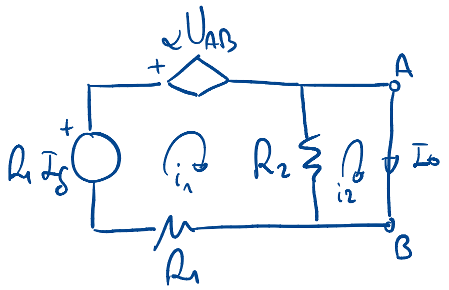
- Intensidad de cortocircuito



$U_{AB} = I_2 R_2 = (I_1 - I_0) R_2$

n_1: $I_1 = I_2 + I_0 \rightarrow I_2 = I_1 - I_0$

Fuente intensidad paralelo con resistencia → fuente tensión serie con resistencia



i_1: $-\alpha U_{AB} + R_1 I_g = i_1(R_1+R_2) - i_2 R_2 \rightarrow$ $U_{AB} = (I_1 - I_0) R_2 = (i_1 - i_2) R_2$

$\rightarrow R_1 I_g = i_1 (R_1 + R_2(1-\alpha)) - i_2 R_2 (1-\alpha)$

i_2: $0 = -i_1 R_2 + i_2 R_2$

$$\hat{e}_g = Z_m \hat{i}_g \rightarrow \begin{pmatrix} R_1 I_g \\ 0 \end{pmatrix} = \begin{pmatrix} R_1 + R_2(1-\alpha) & -R_2(1-\alpha) \\ -R_2 & R_2 \end{pmatrix} \begin{pmatrix} i_1 \\ i_2 \end{pmatrix} \rightarrow \begin{pmatrix} 60 \\ 0 \end{pmatrix} = \begin{pmatrix} 4 & 2 \\ -2 & 2 \end{pmatrix} \begin{pmatrix} i_1 \\ i_2 \end{pmatrix} \rightarrow$$

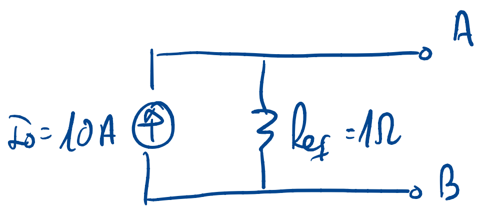
$$i_2 = \frac{\begin{vmatrix} 4 & 60 \\ -2 & 0 \end{vmatrix}}{\begin{vmatrix} 4 & 2 \\ -2 & 2 \end{vmatrix}} = \frac{120}{8+4} = \frac{30}{2+1} = \frac{30}{3} = 10\ A$$

$I_0 = i_2 = 10\ A$

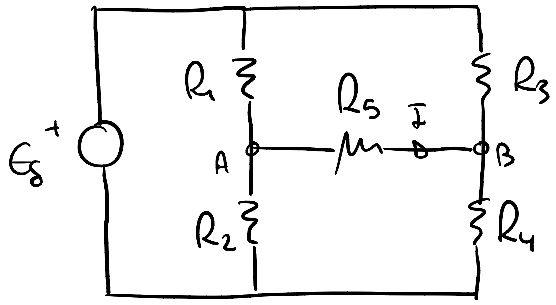
- Resistencia equivalente

$$R_{eq} = \frac{U_0}{I_0} = \frac{10}{10} = 1\ \Omega$$

Equivalente Norton



Ejercicio 3.

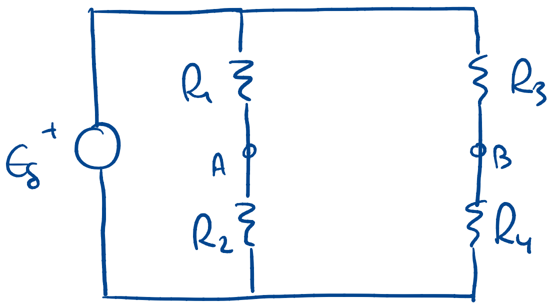


$E_g = 12V$
$R_1 = 6\Omega$
$R_2 = 3\Omega$
$R_3 = R_4 = 4\Omega$

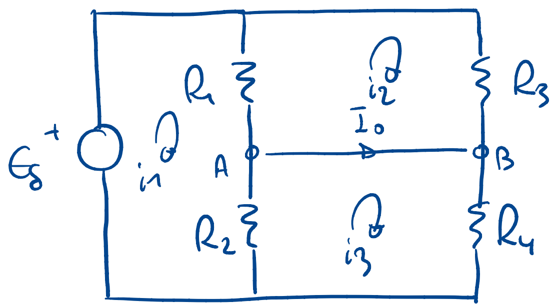
$I = -\frac{1}{3} A$

R_5
Equivalente Thevenin

↓



- Intensidad de cortocircuito



B: $I_0 + i_2 = i_3 \rightarrow I_0 = i_3 - i_2$

i_1: $E_g = i_1(R_1+R_2) - i_2 R_1 - i_3 R_2$

i_2: $0 = -i_1 R_1 + i_2(R_1+R_3)$

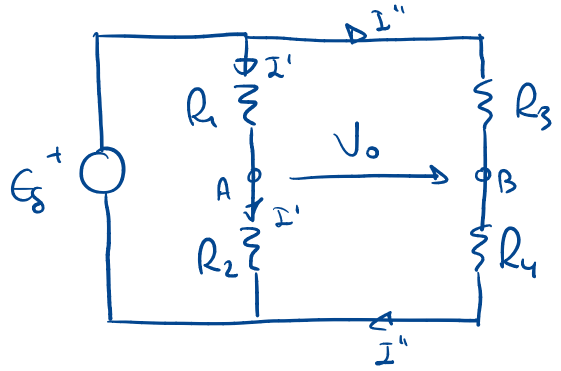
i_3: $0 = -i_1 R_2 + i_3(R_2+R_4)$

$$\hat{e}_g = Z_m \hat{i} \rightarrow \begin{pmatrix} E_g \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} R_1+R_2 & -R_1 & -R_2 \\ -R_1 & R_1+R_3 & 0 \\ -R_2 & 0 & R_2+R_4 \end{pmatrix} \begin{pmatrix} i_1 \\ i_2 \\ i_3 \end{pmatrix} \rightarrow \begin{pmatrix} 12 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 9 & -6 & -3 \\ -6 & 10 & 0 \\ -3 & 0 & 7 \end{pmatrix} \begin{pmatrix} i_1 \\ i_2 \\ i_3 \end{pmatrix}$$

$$i_2 = \frac{\begin{vmatrix} 9 & 12 & -3 \\ -6 & 0 & 0 \\ -3 & 0 & 7 \end{vmatrix}}{\begin{vmatrix} 9 & -6 & -3 \\ -6 & 10 & 0 \\ -3 & 0 & 7 \end{vmatrix}} = \frac{504}{288} = \frac{7}{4} \qquad i_3 = \frac{\begin{vmatrix} 9 & -6 & 12 \\ -6 & 10 & 0 \\ -3 & 0 & 0 \end{vmatrix}}{\begin{vmatrix} 9 & -6 & -3 \\ -6 & 10 & 0 \\ -3 & 0 & 7 \end{vmatrix}} = \frac{360}{288} = \frac{5}{4}$$

$$I_0 = i_3 - i_2 = \frac{5}{4} - \frac{7}{4} = -\frac{2}{4} = -\frac{1}{2} A$$

• Tensión circuito abierto



$$U_o = -I' R_1 + I'' R_3 = -I' \cdot 6 + I'' \cdot 4$$
$$U_o = I' R_2 - I'' R_4 = I' \cdot 3 - I'' \cdot 4$$

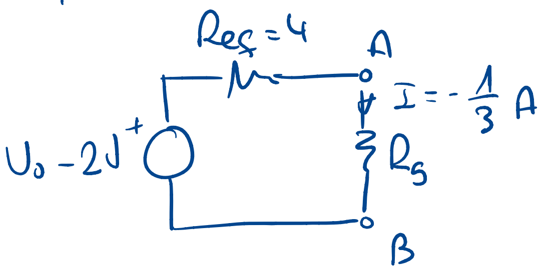
$$E_g = I'(R_1 + R_2) \rightarrow I' = \frac{E_g}{R_1 + R_2} = \frac{12}{6+3} = \frac{4}{3} A$$
$$E_g = I''(R_3 + R_4) \rightarrow I'' = \frac{E_g}{R_3 + R_4} = \frac{12}{4+4} = \frac{3}{2} A$$

$$U_o = -I' \cdot 6 + I'' \cdot 4 = -\frac{4}{3} \cdot 6 + \frac{3}{2} \cdot 4 = -2V$$

• Resistencia equivalente

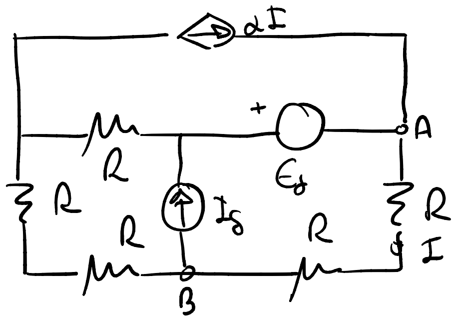
$$R_{eq} = \frac{U_o}{I_o} = \frac{-2}{-1/2} = 4 \Omega$$

Equivalente Thevenin



$$U_o = I(R_{eq} + R_5) \rightarrow R_5 = \frac{U_o}{I} - R_{eq} \rightarrow$$
$$\rightarrow R_5 = \frac{-2}{-1/3} - 4 = 2 \Omega$$

Ejercicio 4.

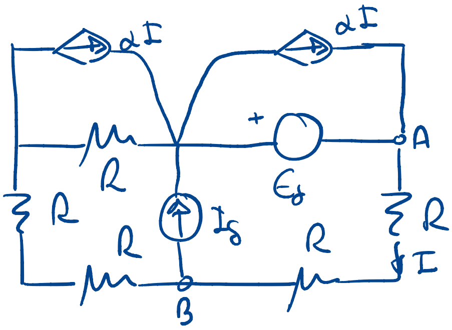


$I_g = 10\,A$
$R = 2\,\Omega$
$E_g = 30\,V$
$\alpha = 3$

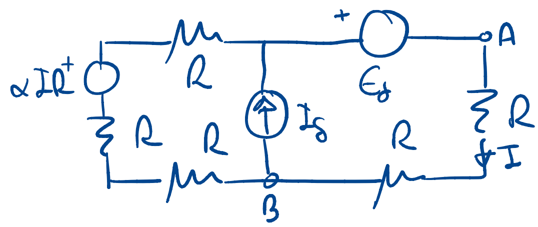
Norton

¿Potencia consumida si en A-B hay una $R = 12\Omega$?

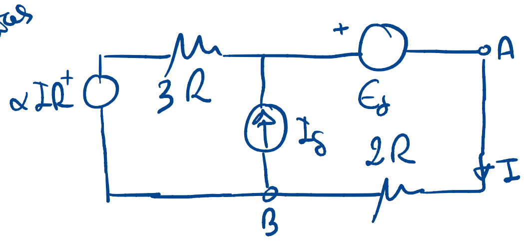
Fuente intensidad en paralelo con elementos



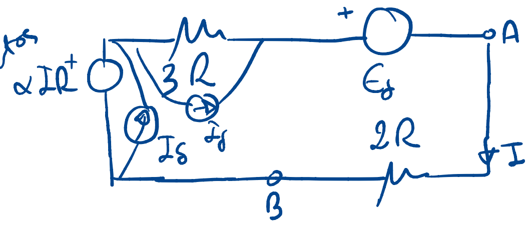
Fuente intens. a fuente tens. Fuent. tens. paralelo → fuent. tens.



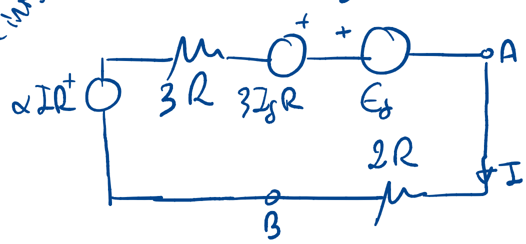
agrupación resistencias



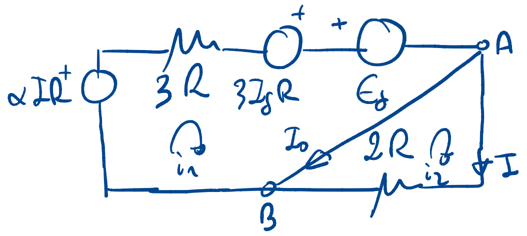
Fuente int. paralelo elementos



transform. fuente int.



- Intensidad cortocircuito



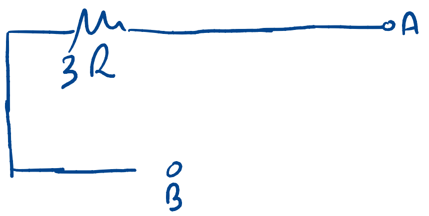
i_1: $\alpha I R + 3I_gR - E_g = i_1 3R \xrightarrow{i_1 = I} 3I_gR - E_g = i_1 3R - \cancel{i_2}^{0}\alpha R$ *

i_2: $0 = i_2 2R \rightarrow i_2 = 0$

$* \; i_1 = \frac{3I_gR - E_g}{3R} = I_g - \frac{E_g}{3R} = 10 - \frac{30}{3\cdot 2} = 10 - 5 = 5A$

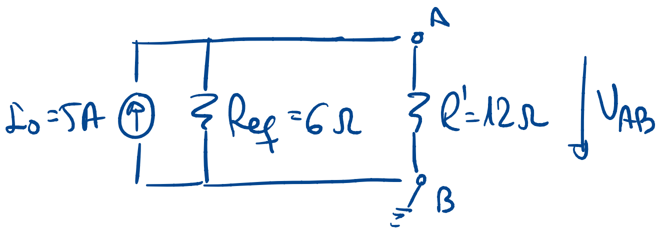
A: $i_1 = \cancel{i_2}^{0} + I_0 = 5A$

- Resistencia equivalente, siendo $I = 0$:



$R_{eq} = 3R = 3\cdot 2 = 6\Omega$

Equivalente Norton

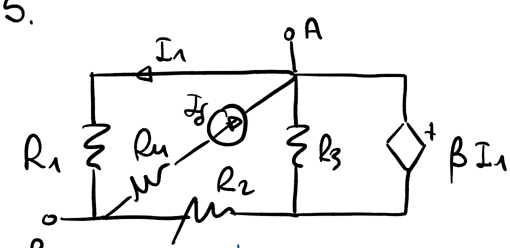


$I_0 = U_{AB}\left(\frac{1}{R_{eq}} + \frac{1}{R'}\right) \rightarrow U_{AB} = I_0\left(\frac{R_{eq}\cdot R'}{R_{eq} + R'}\right)$

$\rightarrow U_{AB} = 5\left(\frac{6\cdot 12}{6+12}\right) = 20\,V$

$P = \frac{U_{AB}^2}{R} = \frac{20^2}{12} = \frac{100}{3}\,W$

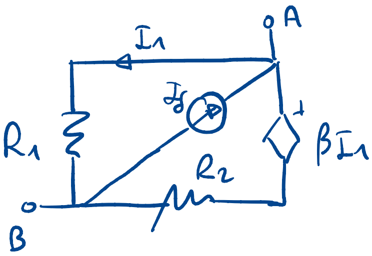
Ejercicio 5.



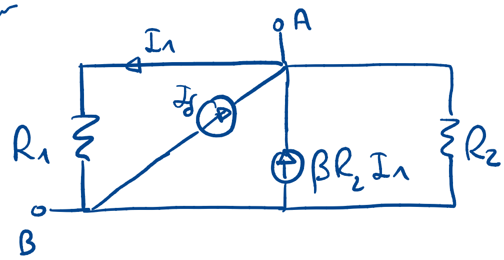
$I_g = 20\,A$ $R_3 = R_4 = 3\,\Omega$
$R_1 = 2\,\Omega$ $\beta = 2\,V/A$
$R_2 = 1\,\Omega$

Eq. Norton
¿Fuente tensión 10 V en A-B, positivo en B, potencia generada?

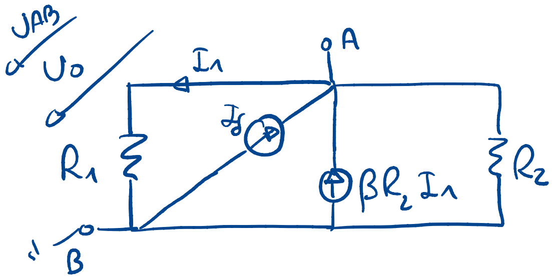
fuente int. serie con elementos
fuente tens. paralelo elementos



fuente tens. serie resistencias a fuente int. con res.



- Tensión a circuito abierto

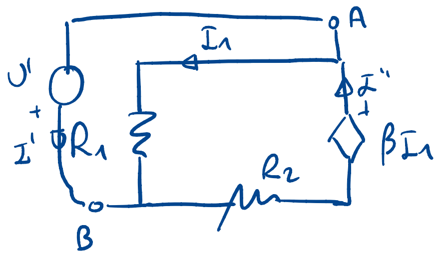


$$\left.\begin{aligned} I_g + \beta R_2 I_1 &= U_{AB}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \\ I_1 &= \frac{U_{AB}}{R_1} \end{aligned}\right\} \rightarrow$$

$$\rightarrow I_g + \beta R_2 \frac{U_{AB}}{R_1} = U_{AB}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \rightarrow I_g = U_{AB}\left(\frac{1}{R_1}\left(1 - \beta R_2\right) + \frac{1}{R_2}\right) \rightarrow$$

$$\rightarrow U_{AB} = \frac{I_g}{\frac{1}{R_1}\left(1 - \beta R_2\right) + \frac{1}{R_2}} = \frac{20}{\frac{1}{2}\left(1 - 2\cdot 1\right) + \frac{1}{1}} = 40\ V$$

- Resistencia equivalente



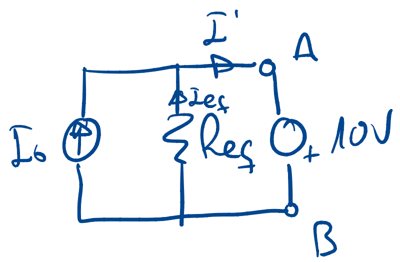
$$U' = I' R_1 - I'' R_1$$
$$I'' = I_1 + I' \rightarrow I_1 = I'' - I'$$
$$\Big\} \; U' = -I_1 R_1 \; *$$

$$R_{eq} = R_1 = 2\,\Omega$$

- Intensidad de cortocircuito

$$I_0 = \frac{U_0}{R_{eq}} = \frac{40}{2} = 20\ A$$

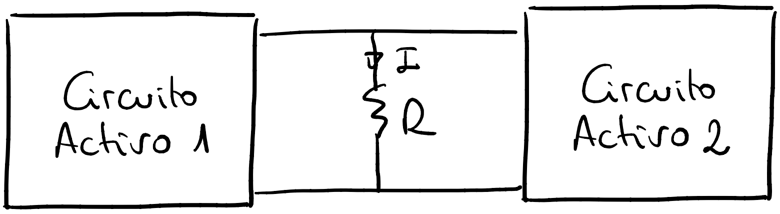
Equivalente Norton



$$I_0 = I' - I_{eq} \rightarrow I' = I_0 + I_{eq}$$
$$I_{eq} = \frac{10}{2} = 5\ A$$
$$\Big\} \; I' = 20 + 5 = 25\ A$$

$$P = V \cdot I = 10 \cdot 25 = 250\ W$$

Ejercicio 6.



Circuito formado por:

- fuente tensión E_g
- fuente intensidad I_g

Si $E_g = 0 \to I = 10\,A$

Si $I_g = 0 \to I = -5\,A$

$R = 5\,\Omega$

¿Potencia en R?

sin fuente

sin int.

$I_R = 10 - 5 = 5\,A$

$P_R = I_R^2 \cdot R = 5^2 \cdot 5 = 5^3 = 125\,W$