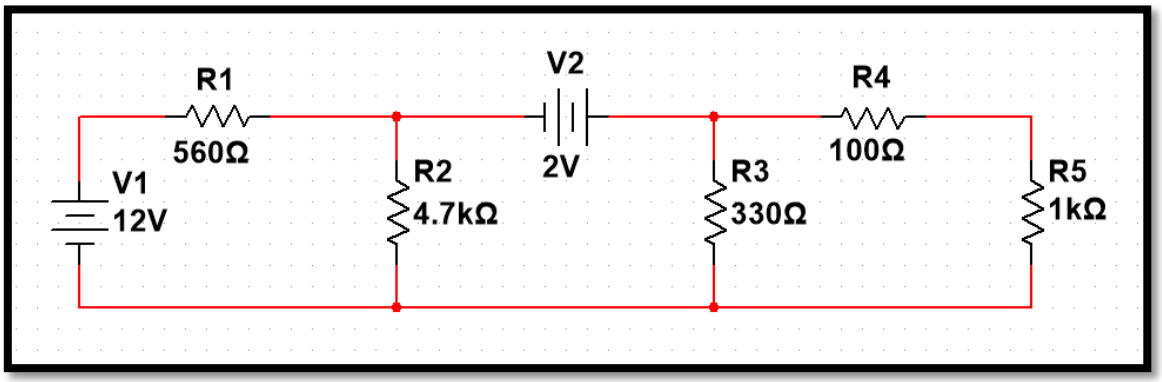
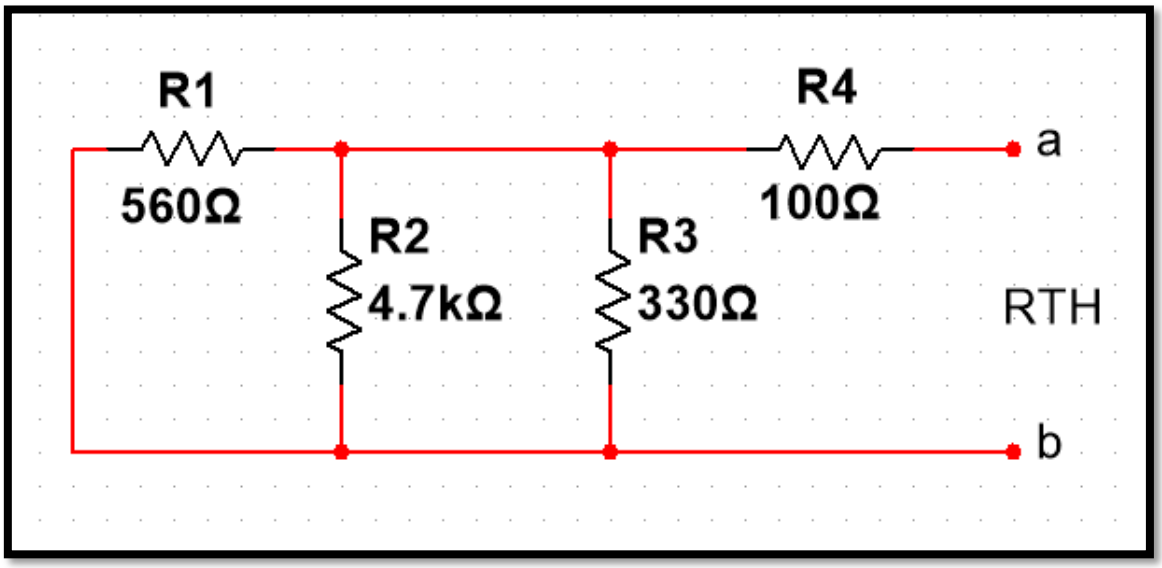
Teorema de Thévenin



- Proceso para calcular Resistencia de Thévenin (R_{TH})



Cálculos.

$$R_{eq1} = \frac{560 * 4700}{560 + 4700} = \mathbf{500,38}\ [\Omega]$$

$$R_{eq2} = \frac{500{,}38 * 330}{500{,}38 + 330} = \mathbf{198,85}\ [\Omega]$$

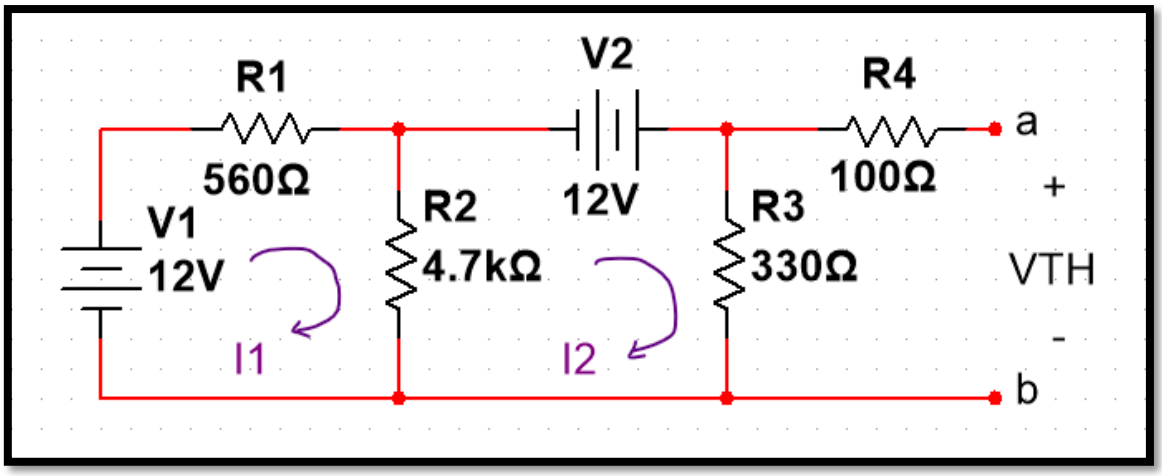
$$R_{eq3} = 198{,}85\ + 100 = \mathbf{298,85}\ [\Omega]$$

$$R_{eq3} = R_{TH} = \mathbf{298,85}\ [\Omega]$$

- Resistencia (R_{TH})

$$R_{TH} = \mathbf{298,85}\ [\Omega]$$

- Proceso para calcular Voltaje de Thévenin (V_{TH})



- Malla 1

$$5260\,\boldsymbol{I1} - 4700\,\boldsymbol{I2} = 12 \qquad (\mathbf{1})$$

- Malla 2

$$-4700\,\boldsymbol{I1} + 5030\,\boldsymbol{I2} = 2 \qquad (\mathbf{2})$$

- Sistema de ecuaciones de 2x2

$$\begin{cases} 5260\,\boldsymbol{I1} - 4700\,\boldsymbol{I2} = 12 \\ -4700\,\boldsymbol{I1} + 5030\,\boldsymbol{I2} = 2 \end{cases}$$

La solución por la regla de Cramer

$$\begin{cases} 5260 \cdot x_1 - 4700 \cdot x_2 = 12 \\ -4700 \cdot x_1 + 5030 \cdot x_2 = 2 \end{cases}$$

$$\equiv$$

$$\Delta = \begin{vmatrix} 5260 & -4700 \\ -4700 & 5030 \end{vmatrix} = 4367800$$

$$\equiv$$

▼ Los detalles

$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} \cdot a_{22} - a_{12} \cdot a_{21}(?)$$

$$\begin{vmatrix} 5260 & -4700 \\ -4700 & 5030 \end{vmatrix} = 5260 \cdot 5030 - (-4700) \cdot (-4700) = 4367800$$

$$\equiv$$

$$\Delta_1 = \begin{vmatrix} 12 & -4700 \\ 2 & 5030 \end{vmatrix} = 69760;$$

$$\equiv$$

▼ Los detalles

$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} \cdot a_{22} - a_{12} \cdot a_{21}(?)$$

$$\begin{vmatrix} 12 & -4700 \\ 2 & 5030 \end{vmatrix} = 12 \cdot 5030 - (-4700) \cdot 2 = 69760$$

$$\equiv$$

$$\Delta_2 = \begin{vmatrix} 5260 & 12 \\ -4700 & 2 \end{vmatrix} = 66920;$$

$$\equiv$$

▼ Los detalles

$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} \cdot a_{22} - a_{12} \cdot a_{21}(?)$$

$$\begin{vmatrix} 5260 & 12 \\ -4700 & 2 \end{vmatrix} = 5260 \cdot 2 - 12 \cdot (-4700) = 66920$$

$$\equiv$$

$$x_1 = \Delta_1 / \Delta = \frac{69760}{4367800} = 0{,}0160$$

$$x_2 = \Delta_2 / \Delta = \frac{66920}{4367800} = 0{,}0153$$

La respuesta:

$$x_1 = 0{,}0160$$

$$x_2 = 0{,}0153$$

$$\boldsymbol{X1 = I1} = 0{,}0160\ [A] \rightarrow \mathbf{16}\ [\boldsymbol{mA}]$$

$$X2 = \boldsymbol{I2} = 0{,}0153\ [A] \rightarrow \mathbf{15{,}3}\ [\boldsymbol{mA}]$$

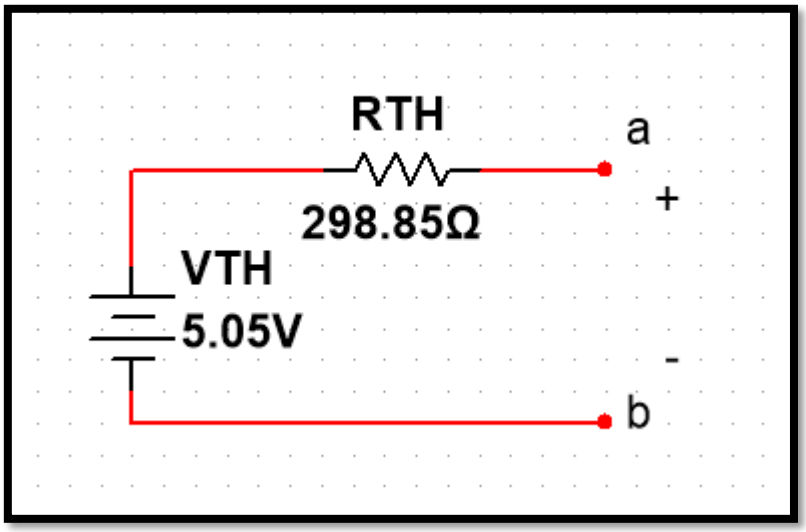
- Voltaje (V_{TH})

$$\mathbf{V} = \mathbf{I} * \mathbf{R} \quad \rightarrow \quad \text{Ley de Ohm}$$

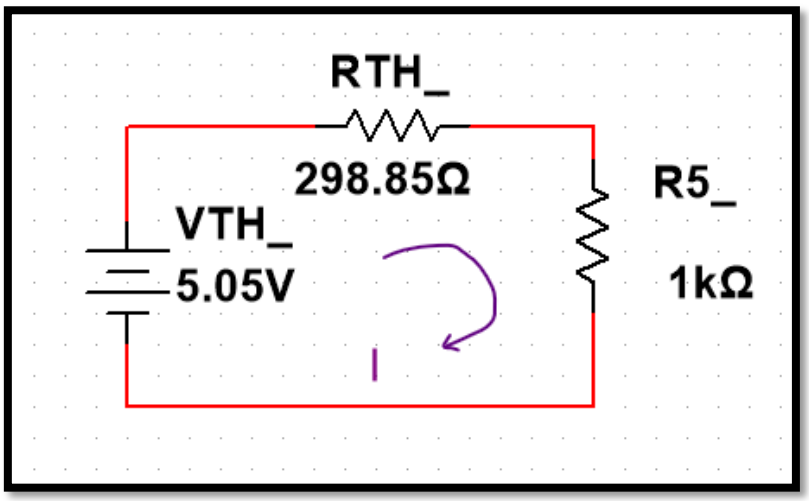
$$\boldsymbol{V_{TH}} = \mathbf{330}\ * \boldsymbol{I2}$$

$$\boldsymbol{V_{TH}} = 0{,}0153\ [A] \rightarrow \mathbf{5{,}05}\ [\boldsymbol{V}]$$

- Circuito Thévenin



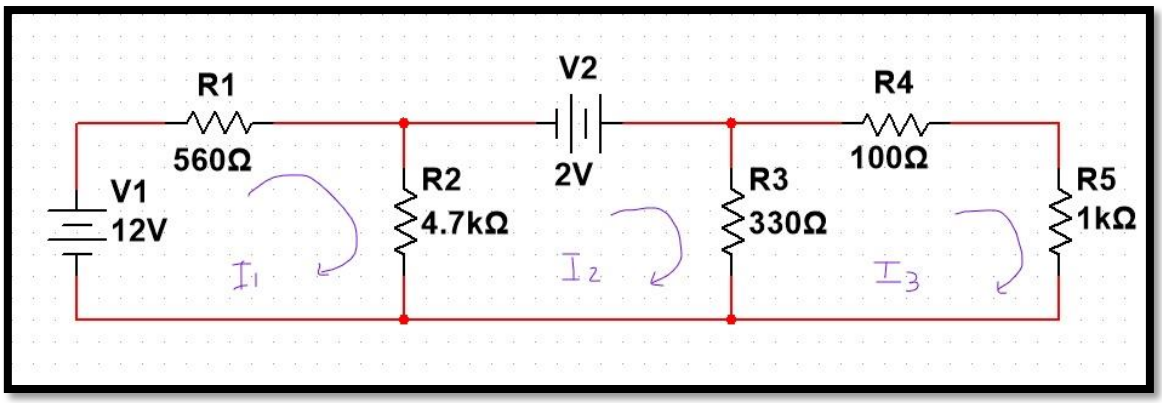
- Implementación R5= 1K



$$\mathbf{I} = \frac{5{,}05}{1298{,}85} = 0{,}00388805481[A] \rightarrow \mathbf{I} = \mathbf{3{,}89}[\boldsymbol{mA}]$$

$$\boldsymbol{V_{1k}} = \boldsymbol{I}(\mathbf{1}) = \mathbf{3{,}89}\ [\mathbf{mV}]$$

- Cálculo de voltaje en R5= 1k



- Malla 1

$$5260\,\boldsymbol{I1} - 4700\,\boldsymbol{I2} = 12 \qquad (\mathbf{1})$$

- Malla 2

$$-4700\boldsymbol{I1} + 5030\boldsymbol{I2} - \mathbf{330}\boldsymbol{I3} = 2 \qquad (\mathbf{2})$$

- Malla 3

$$1430\,\boldsymbol{I3} - 330\boldsymbol{I2} = 0 \qquad (\mathbf{3})$$

- Sistema de ecuaciones de 3x3

$$\begin{cases} 5260I_1 - 4700I_2 = 12 \\ -4700I_1 + 5030I_2 - 330I_3 = 2 \\ 1430I_3 - 330I_2 = 0 \end{cases}$$

La solución por la regla de Cramer

$$\begin{cases} 5260 \cdot x_1 - 4700 \cdot x_2 = 12 \\ -4700 \cdot x_1 + 5030 \cdot x_2 - 330 \cdot x_3 = 2 \\ -330 \cdot x_2 + 1430 \cdot x_3 = 0 \end{cases}$$

$$\equiv$$

$$\Delta = \begin{vmatrix} 5260 & -4700 & 0 \\ -4700 & 5030 & -330 \\ 0 & -330 & 1430 \end{vmatrix} = 5673140000$$

$$\equiv$$

► Los detalles (Regla de triángulo)

...

$$\Delta_1 = \begin{vmatrix} 12 & -4700 & 0 \\ 2 & 5030 & -330 \\ 0 & -330 & 1430 \end{vmatrix} = 98450000;$$

$$\equiv$$

► Los detalles (Regla de triángulo)

...

$$\Delta_2 = \begin{vmatrix} 5260 & 12 & 0 \\ -4700 & 2 & -330 \\ 0 & 0 & 1430 \end{vmatrix} = 95695600;$$

$$\equiv$$

► Los detalles (Regla de triángulo)

...

$$\Delta_3 = \begin{vmatrix} 5260 & -4700 & 12 \\ -4700 & 5030 & 2 \\ 0 & -330 & 0 \end{vmatrix} = 22083600;$$

$$\equiv$$

► Los detalles (Regla de triángulo)

...

$$x_1 = \Delta_1 / \Delta = \frac{98450000}{5673140000} = 0{,}0174$$

$$x_2 = \Delta_2 / \Delta = \frac{95695600}{5673140000} = 0{,}0169$$

$$x_3 = \Delta_3 / \Delta = \frac{22083600}{5673140000} = 0{,}00389$$

La respuesta:

$$x_1 = 0{,}0174$$

$$x_2 = 0{,}0169$$

$$x_3 = 0{,}00389$$

$$\boldsymbol{X1} = \boldsymbol{I1} = 0{,}0174\ [A] \rightarrow \mathbf{17{,}4}\ [\boldsymbol{mA}]$$

$$X2 = \boldsymbol{I2} = 0{,}0169\ [A] \rightarrow \mathbf{16,9}\ [\boldsymbol{mA}]$$

$$X3 = \boldsymbol{I3} = 0{,}00389\ [A] \rightarrow \mathbf{3,89}\ [\boldsymbol{mA}]$$

- Voltaje en R5 = 1k

$$V_{1k} = \mathbf{3,89}\ [\boldsymbol{V}]$$