Problema 2 - Libro

a) Calcular la resistencia equivalente entre A y B.

b) Si $V_A - V_B = 12V$, determinar la corriente en cada resistencia.

Datos

$R_1 = 6\Omega$

$R_2 = R_4 = R_5 = 4\Omega$

$R_3 = 2\Omega$

$R_6 = R_7 = 8\Omega$

En serie → $R_A = R_3 + R_4 = 6\Omega$

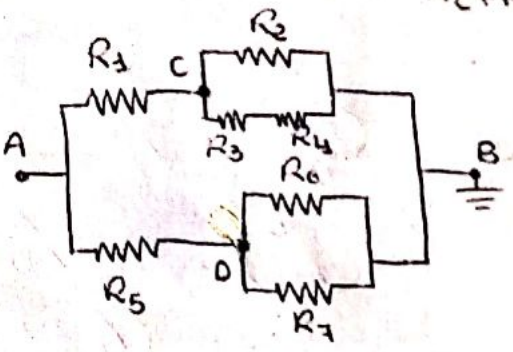
$\frac{1}{R_B} = \frac{1}{R_2} + \frac{1}{R_A} \Rightarrow R_B = \frac{12}{5}\Omega$

$R_C = R_1 + R_B = 6 + \frac{12}{5} = \frac{42}{5}\Omega$ } Rama superior

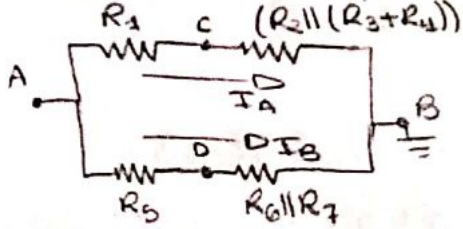
$\frac{1}{R_D} = \frac{1}{R_6} + \frac{1}{R_7} \Rightarrow R_D = 4\Omega$

$R_E = R_5 + R_D = 4 + 4 = 8\Omega$ } Rama inferior

$$R_{Final} = \frac{R_C R_E}{R_C + R_E} = \frac{168}{41}\Omega$$



Necesitamos conocer las tensiones en los nudos esenciales (B, C, D). Ponemos el nudo B como el nudo de referencia, por lo que $V_B = 0$ y como $V_A - V_B = 12V$, $V_A = 12V$. Dibujo un sistema equivalente:



Por la ley de Ohm:

$$I_A = \frac{V_A - V_B}{R_1 + (R_2 \| (R_3 + R_4))} = \frac{12}{6 + \frac{12}{5}} = 1.428A$$

$$I_B = \frac{V_A - V_B}{R_5 + R_6 \| R_7} = \frac{12}{4+4} = 1.5A$$

$$V_C - V_A = -I_A R_1 \Rightarrow V_C = -1.428 \cdot 6 + 12 = 3.432V$$

$$V_D - V_A = -I_B R_5 \Rightarrow V_D = -1.5 \cdot 4 + 12 = 6V$$

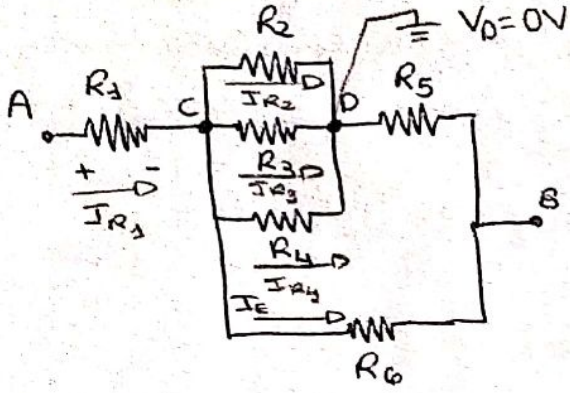
$$I_{R_1} = I_A \quad I_{R_2} = \frac{V_C - V_B}{R_2} \quad I_{R_3} = I_{R_4} = \frac{V_C - V_B}{I_3 + I_4}$$

$$I_{R_5} = I_B \quad I_{R_6} = \frac{V_D - V_B}{R_6} \quad I_{R_7} = \frac{V_D - V_B}{R_7}$$

Problema 3.- Libro

Considere el siguiente circuito donde la caída de tensión a través de la resistencia R_1 es 100V.

a) ¿$I_{R_2}, I_{R_3}, I_{R_4}$? b) ¿$\Delta V$ en R_2? c) ¿P consumida por R_6?



Datos

$R_1 = 10\Omega$ $R_4 = 6\Omega$

$\Delta V_{R_1} = 100V$ $R_5 = 2\Omega$

$R_2 = 5\Omega$ $R_6 = 20\Omega$

$R_3 = 3\Omega$

Ley de Ohm

$$I_{R_1} = \frac{\Delta V_{R_1}}{R_1} = \frac{100}{10} = 10A$$

Aplico ley de nudos:

C $\quad I_{R_1} = I_{R_2} + I_{R_3} + I_{R_4} + I_E$

$$I_{R_2} = \frac{V_C - V_0}{R_2} = \frac{V_C}{R_2} \quad I_{R_3} = \frac{V_C}{R_3} \quad I_4 = \frac{V_C}{R_4} \quad I_E = \frac{V_C}{\underbrace{R_5 + R_6}_{\text{En serie}}}$$

$$\Rightarrow 10 = \frac{V_C}{R_2} + \frac{V_C}{R_3} + \frac{V_C}{R_4} + \frac{V_C}{R_5+R_6} \Rightarrow 10 = V_C\left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5+R_6}\right)$$

$$V_C = \frac{10}{\frac{1}{5} + \frac{1}{3} + \frac{1}{6} + \frac{1}{22}} = 13.41V \Rightarrow I_{R_2} = 2.683A \quad a)$$

$I_{R_3} = 4.4715A$

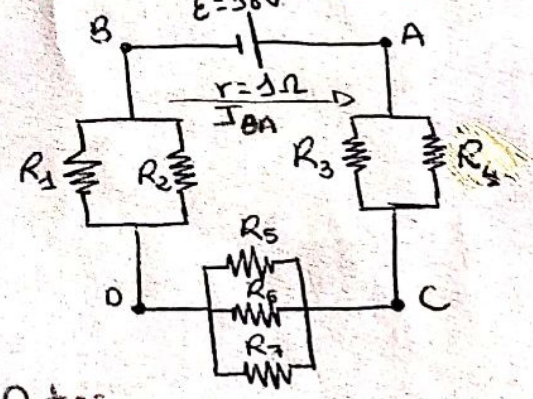
$I_{R_4} = 2.24A$

$I_E = 0.60975A$

b) $\Delta V_{R_2} = V_C - \cancel{V_0}^{0} = 13.41V$

c) $P_{R_6} = I_E^2 \cdot R_6 = 0.60975^2 \cdot 20 = 7.4359W$

Problema 4 - Libro (6 Relación)



Datos

$R_1 = R_4 = R_5 = 3\Omega$

$R_2 = 6\Omega$

$R_3 = R_6 = 1.5\Omega$

$R_7 = 1\Omega$

a) Calcular la resistencia equivalente entre A y B.

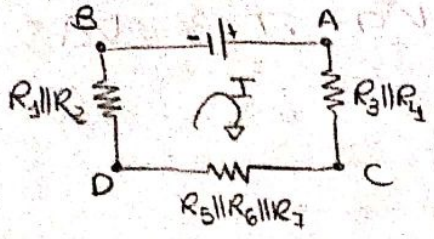
$$\frac{1}{R_1 \| R_2} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_1 \| R_2 = 2\Omega$$

$$\frac{1}{R_3 \| R_4} = \frac{1}{R_3} + \frac{1}{R_4} \Rightarrow R_3 \| R_4 = 1\Omega$$

$$\frac{1}{R_5 \| R_6 \| R_7} = \frac{1}{R_5} + \frac{1}{R_6} + \frac{1}{R_7} = \frac{1}{2}\Omega$$

$$R_T = R_1 \| R_2 + R_3 \| R_4 + R_5 \| R_6 \| R_7 = \frac{7}{2}\Omega$$

b) La corriente que circula por el punto A.



Aplico ley de mallas:

$\Sigma \mathcal{E} = \Sigma I R$

$\hookrightarrow \mathcal{E} = Ir + I R_1 \| R_2 + I R_3 \| R_4 + I R_5 \| R_6 \| R_7$

$18 = I + 2I + I + \frac{1}{2} I \Rightarrow I = 4A$

c) La intensidad en todos los hilos.

Conecto a tierra el nudo B, por lo que $V_B = 0$

$\Delta V_{AB} = \mathcal{E} - Ir = 18 - 4 \cdot 1 = 14V$

$V_A - \cancel{V_B}^{0} = 14 \Rightarrow V_A = 14V$

$I_{R_3} = \frac{V_A - V_C}{R_3} \quad I = \frac{V_A - V_C}{R_3 \| R_4} \Rightarrow 4 = \frac{14 - V_C}{1} \Rightarrow V_C = 10V$

$\hookrightarrow I_{R_3} = \frac{14 - 10}{1.5} = 2.\widehat{6}A$

$I_{R_4} = \frac{V_A - V_C}{R_4} = \frac{14 - 10}{3} = 1.\widehat{3}A$

$I = \frac{V_C - V_D}{R_5 \| R_6 \| R_7} \Rightarrow 4 = \frac{10 - V_D}{1/2} \Rightarrow V_D = 8V$

$I_{R_5} = \frac{V_C - V_D}{R_5} = \frac{10 - 8}{3} = 0.\widehat{6}A \quad I_{R_6} = \frac{V_C - V_D}{R_6} = \frac{10 - 8}{1.5} = 1.\widehat{3}A$

$I_{R_7} = \frac{V_C - V_D}{R_7} = \frac{10 - 8}{1} = 2A \quad I_{R_1} = \frac{V_D - \cancel{V_B}^{0}}{R_1} = \frac{8}{3} = 2.\widehat{6}A$

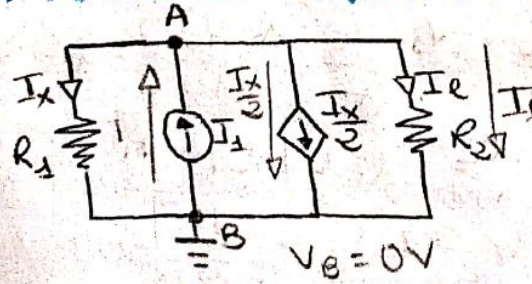
$I_{R_2} = \frac{V_D - \cancel{V_B}^{0}}{R_2} = \frac{8}{6} = 1.\widehat{3}A$

d) ¿$V_{AB}, V_{AC}, V_{CD}, V_{DB}$?

$V_{DB} = V_D - \cancel{V_B}^{0} = 8V \quad V_{AB} = V_A - \cancel{V_B}^{0} = 14V$

$V_{CD} = V_C - V_D = (10 - 8)V = 2V \quad V_{AC} = V_A - V_C = (14 - 10)V = 4V$

Problema 5 Libro



Determinar I_ℓ

Datos

$I_1 = 6mA \quad R_1 = 2k\Omega \quad R_2 = 4k\Omega$

Aplico ley de nudos:

(A) $I_1 = I_x + \frac{I_x}{2} + I_\ell \Rightarrow 6 \cdot 10^{-3} = \frac{V_A}{2000\Omega} + \frac{V_A}{4000\Omega} + \frac{V_A}{4000\Omega}$

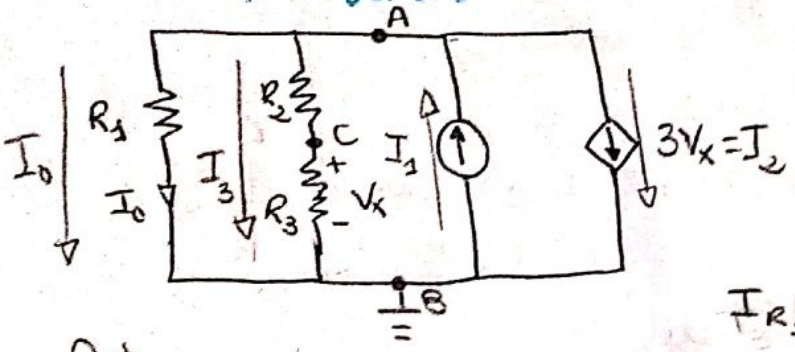
$V_A = \frac{6 \cdot 10^{-3}}{\frac{1}{2000} + \frac{1}{4000} + \frac{1}{4000}} = 6V$

$I_x = \frac{V_A - \cancel{V_B}^{0}}{R_1}$

$I_\ell = \frac{V_A - \cancel{V_B}^{0}}{R_2}$

$I_\ell = \frac{V_A}{R_2} = 0.0015A = 1.5mA$

Problema 7 Libro



Aplico ley de nudos:

[A] $I_1 = I_0 + I_3 + 3V_x$

$I_0 = \frac{V_A - \cancel{V_B}^{0}}{R_1} = \frac{V_A}{R_1}$

$I_{R_2} = I_{R_3}$ porque están en serie.

$\frac{V_A - V_C}{R_2} = \frac{V_C - \cancel{V_B}^{0}}{R_3}$

$V_A = \frac{V_C}{R_3} \cdot R_2 + V_C$

Datos

$I_1 = 5A$

$R_1 = 6\Omega$

$R_2 = 8\Omega$

$R_3 = 4\Omega$

$5 = \frac{V_A}{R_1} + \frac{V_A - \cancel{V_B}^{0}}{R_2 + R_3} + 3V_x \Rightarrow 5 = \underbrace{\frac{\frac{V_C}{R_3} \cdot R_2 + V_C}{R_1} + \frac{\frac{V_C}{R_3} \cdot R_2 + V_C}{R_2 + R_3}} + 3V_C$

$V_x = V_C - \cancel{V_B}^{0} \Rightarrow V_x = V_C$

$5 = \underbrace{\frac{3V_C}{6} + \frac{3V_C}{12}} + 3V_C$

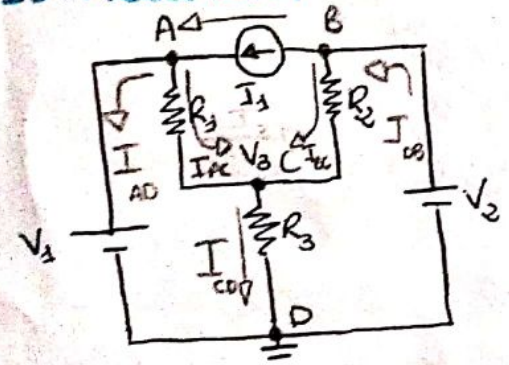
$60 = 6V_C + 3V_C + 36V_C$

$-3V_x + 5 = V_A\left(\frac{1}{R_1} + \frac{1}{R_2 + R_3}\right)$

$V_C = \frac{4}{3}V = V_x$

$\Rightarrow V_A = \frac{-4 + 5}{\frac{1}{6} + \frac{1}{12}} = 4V \Rightarrow I_0 = \frac{V_A}{R_1} = \frac{4}{6} = 0.\widehat{6}A$

11. Relación



Ley de nudos $\Sigma I_{entran} = \Sigma I_{salen}$

[A] $I_1 = I_{AD} + I_{AC}$ $\quad I_1 = 0.002A$

[B] $I_{DB} = I_1 + I_{BC}$

[C] $I_{AC} + I_{AB} = I_{CD} \Rightarrow I_{AC} + I_1 = I_{CD}$

$I_{AC} = \frac{V_A - V_C}{R_1} = \frac{V_1 - V_C}{R_1} = \frac{1 - V_C}{1000} = 0.0005A$

$I_{CD} = \frac{V_C - \cancel{V_D}^{0}}{R_3} = \frac{V_C}{1000} = 0.0015A$

$I_{BC} = \frac{V_B - V_C}{R_2} = \frac{V_2 - V_C}{R_2} = \frac{2 - V_C}{1000} = 0.0005A$

Datos

$R_1 = R_2 = R_3 = 1000\Omega$

$I_1 = 0.002A$

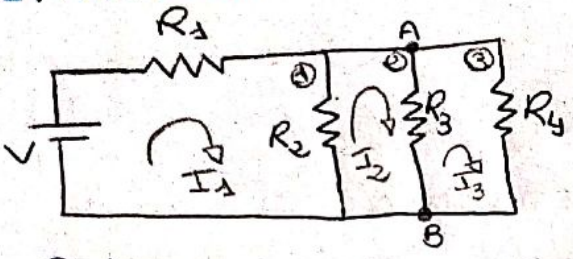
$V_1 = 1V$

$V_2 = 2V$

[C] $\frac{1 - V_C}{1000} + 0.002A = \frac{V_C}{1000}$

$1 - V_C + 2 = V_C \Rightarrow 3 = 2V_C \Rightarrow V_C = 1.5V$

9. Relación



Datos

$V = 12V$

$R_1 = 2000\Omega$

$R_2 = R_3 = R_4 = 6000\Omega$

¿Corrientes rama?

¿Potencia por resistencia?

Método de mallas

1º) $n = 2$

2º) $r = 4$ $\quad$ nº mallas indep. $= r - (n-1) = 3$

3º) Aplico ley de mallas:

$$\Sigma \mathcal{E} = \Sigma I \cdot R$$

Malla 1

$$V = I_1(R_1 + R_2) - I_2 R_2$$

Malla 2

$$0 = I_2(R_2 + R_3) - I_1 R_2 - I_3 R_3$$

Malla 3

$$0 = I_3(R_3 + R_4) - I_2 R_3$$

$$\begin{cases} 12 = I_1 \cdot 8000 - I_2 6000 \\ 0 = I_2 \cdot 12000 - I_1 6000 - I_3 6000 \\ 0 = I_3 \cdot 12000 - I_2 \cdot 6000 \end{cases}$$

$$\hookrightarrow \begin{cases} 6000a - 12000b + 6000c = 0 \\ 6000b - 12000c = 0 \\ 8000a - 6000b = 12 \end{cases} \Rightarrow \begin{array}{l} 12000a - 18000b = 0 \\ 8000a - 6000b = 12 \end{array}$$

$$\begin{array}{l} \hookrightarrow \\ \cdot(-3) \hookrightarrow \end{array} \begin{array}{l} 12000a - 18000b = 0 \\ -24000a + 18000b = -36 \\ \hline -12000a = -36 \end{array}$$

$$\boxed{I_1 = 0.003A}$$

$$12 = 0.003 \cdot 8000 - I_2 \cdot 6000$$

$$\hookrightarrow \boxed{I_2 = 0.002A}$$

$$0 = 0.002 \cdot 12000 - 0.003 \cdot 6000 - I_3 6000$$

$$\hookrightarrow \boxed{I_3 = 0.001A}$$

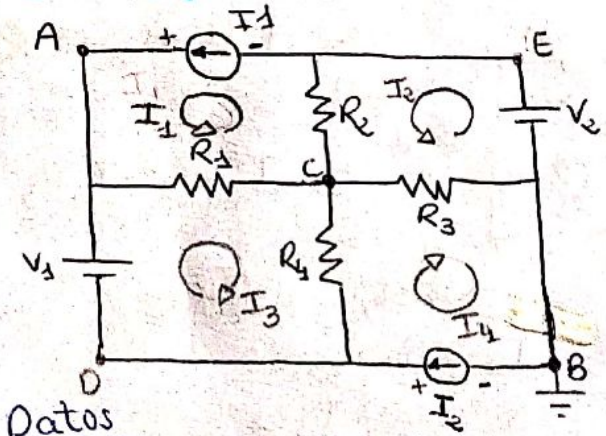
Corriente rama $R_1 = I_1 \Rightarrow P_{R_1} = I \cdot \Delta V = 0.003 \cdot 12 = 0.036W$

* Corriente rama R_2: $I_{R_2} = I_1 - I_2 = 0.001A \Rightarrow P_{R_2} = I \cdot \Delta V = 0.001 \cdot 12 = 0.012W$

Corriente rama R_3: $I_{R_3} = I_2 - I_3 = 0.001A \Rightarrow P_{R_3} = I \cdot \Delta V = 0.001 \cdot 12 = 0.012W$

Corriente rama R_4: $I_{R_4} = I_3 = 0.001A \Rightarrow P_{R_4} = I \cdot \Delta V = 0.001 \cdot 12 = 0.012W$

13. Relación



Datos

$V_1 = V_2 = 6V \quad I_1 = I_2 = 1mA$

$R_2 = R_3 = 10k\Omega \quad R_1 = R_4 = 6k\Omega$

Método de mallas

Hay 4 mallas independientes.

Uso ley de mallas: $\Sigma \mathcal{E} = \Sigma IR$

Malla 1

$$\mathcal{E}_{I_1} = I_1(R_1 + R_2) + I_3 R_1 - I_2 R_2$$

Malla 2

$$V_2 = I_2(R_2 + R_3) - I_1 R_2 + I_4 R_3$$

Malla 3

$$V_1 = I_3(R_1 + R_4) + I_1 R_1 - I_4 R_4$$

Malla 4

$\mathcal{E}_{I_2} = I_4(R_3+R_4)+I_2R_3-I_3R_4$

$$\begin{cases} \mathcal{E}_{I_1} = 16+6000I_3-10000I_2 \Rightarrow \mathcal{E}_{I_1} = 16V \\ 6 = 20000I_2 - 10 + 10 \Rightarrow I_2 = 0.0003A \\ 6 = 12000I_3 \Rightarrow I_3 = 0.0005A \\ \mathcal{E}I_2 = 16 + I_2 10000 - I_3 6000 \Rightarrow \mathcal{E}_{I_2} = 16V \end{cases}$$

a) ¿Potencia aportada por las fuentes al circuito?

$P_{I1} = I \cdot \Delta V = 0.001 \cdot 16 = 0.016W$

$P_{I2} = I \cdot \Delta V = 0.001 \cdot 16 = 0.016W$

$P_{V1} = I \cdot \Delta V = I_3 \cdot V1 = 0.0005 \cdot 6 = 0.003\ W$

$P_{V2} = I \cdot \Delta V = I_2 \cdot V2 = 0.0003 \cdot 6 = 0.0018W$

b) ¿Potencia disipada por las resistencias?

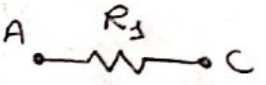
c) ¿Tensión en C? ¿ΔV entre A y B?

$V_A - V_E = 16$

$V_E - V_B = 6$

$V_A - \cancel{V_B}^{0} = 22 \Rightarrow V_A = 22V$

$\boxed{V_A - V_B = 22V}$



$V_A = 22V \quad R_1 = 6000\Omega$

$I = I_1 + I_3 = 0.0015A$

$V_A - V_C = I \cdot R_1$

$\boxed{V_C = V_A - I \cdot R_1 = 22 - 0.0015 \cdot 6000 = 13V}$

$P_{R_1} = I \cdot \Delta V = 0.0015 \cdot (22-13) = 0.0135\ W$

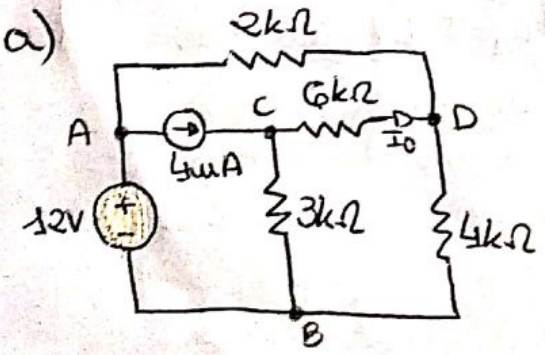
$P_{R_2} = I \cdot \Delta V = (0.001 - 0.0003) \cdot (13-6) = 0.0049\ W$

$P_{R_3} = I \cdot \Delta V = (0.001 + 0.0003) \cdot (13-0) = 0.0169\ W$

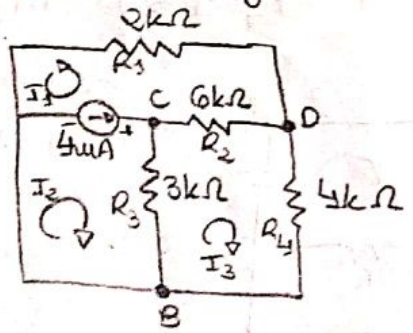
$P_{R_4} = I \cdot \Delta V = (0.001 - 0.0005) \cdot (16-13) = 0.0015\ W$

2º. Relación

a)



Anulo la fuente de tensión:



Malla 1

$\mathcal{E}_I = I_1(R_1+R_2)+I_3R_2$

Malla 2

$\mathcal{E}_I = I_2(R_3) - I_3R_3$

Malla 3

$0 = I_3(R_2+R_3+R_4) - I_2R_3 + I_1R_2$

$\mathcal{E}_I = 8.52V$

$I_1 = 0.000717A$

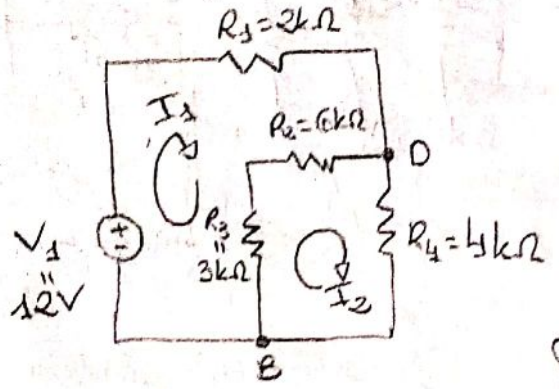
$I_2 = 0.003225A$

$I_3 = 0.000387A$

$$\begin{cases} \mathcal{E}_I = I_1 8000 + I_3 6000 \\ \mathcal{E}_I = I_2 3000 - I_3 3000 \\ 0 = I_3 13000 - I_2 3000 + I_1 6000 \\ I_1 + I_2 = 0.004 \end{cases}$$

$I_0^1 = I_1 + I_3 = 0.001157\,A$

Anulo la fuente de corriente



Uso ley de mallas:

Malla 1

$V_1 = I_1(R_1+R_2+R_3) - I_2R_2 - I_2R_3$

Malla 2

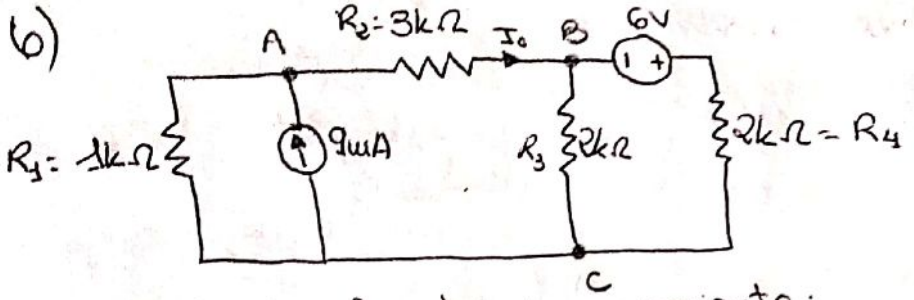
$0 = I_2(R_2+R_3+R_4) - I_1R_2 - I_1R_3$

$$\begin{cases} 12 = 11000I_1 - 9000I_2 \\ 0 = 13000I_2 - 9000I_1 \end{cases} \Rightarrow \begin{matrix} I_1 = 0.00252A \\ I_2 = 0.00174A \end{matrix}$$

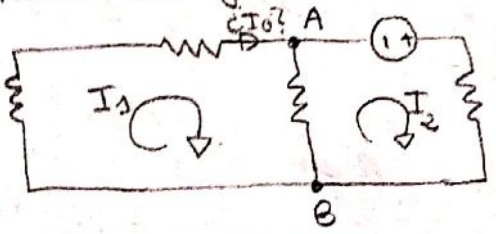
$I_0^2 = I_1 - I_2 = 0.00078\,A$

$I_0 = I_0^1 - I_0^2 = 0.000377\,A$ (→ En este sentido)

6)



Anulo la fuente de corriente:



Uso ley de mallas:

Malla 1

$0 = I_1(R_1+R_2+R_3) - I_2R_3$

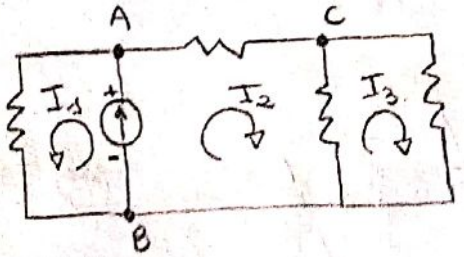
Malla 2

$V_1 = I_2(R_3+R_4) - I_1R_3$

$$\begin{cases} 0 = 6000I_1 - 2000I_2 \\ 6 = 4000I_2 - 2000I_1 \end{cases} \begin{matrix} I_1 = 0.0006A \\ I_2 = 0.0018A \end{matrix}$$

$\boxed{I_0^1 = I_1 = 0.0006A}$

Anulo la fuente de tensión:



Uso ley de mallas:

Malla 1

$\mathcal{E}_I = I_1R_1$

Malla 2

$\mathcal{E}_I = I_2(R_2+R_3) - I_3R_3$

Malla 3

$0 = I_3(R_3+R_4) - I_2R_3$

Cuarta ecuación

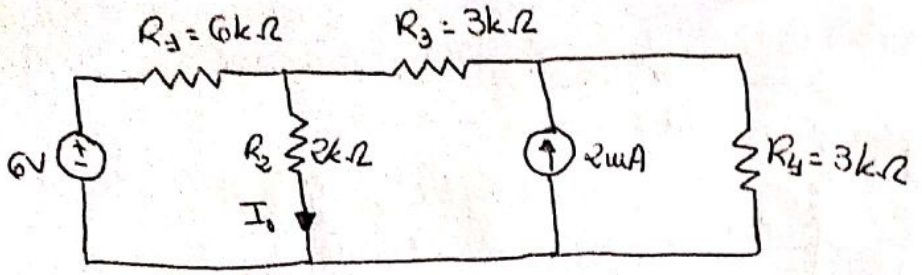
$I_1 + I_2 = 0.009$

$$\begin{cases} \mathcal{E}_I = 1000I_1 \\ \mathcal{E}_I = 5000I_2 - 2000I_3 \\ 0 = 4000I_3 - 2000I_2 \\ I_1 + I_2 = 0.009 \end{cases}$$

$I_2 = 0.0018A$ (→) $\Rightarrow I_0^2 = 0.0018A$

$\boxed{I_0 = I_0^1 + I_0^2 = 0.0024A}$

c)



Anulo la fuente de corriente:

Malla 1

$V_1 = I_1(R_1+R_2) - I_2R_2$

Malla 2

$0 = I_2(R_2+R_3+R_4) - I_1R_2$

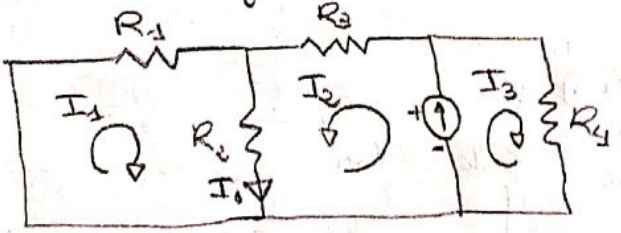
$$\begin{cases} 6 = 8000I_1 - 2000I_2 \\ 0 = 8000I_2 - 2000I_1 \end{cases}$$

$I_1 = 0.0008A$

$I_2 = 0.0002A$

$I_0^1 = I_1 - I_2 = 0.0006A\ (\downarrow)$

Anulo la fuente de tensión:



Malla 1

$0 = I_1(R_1+R_2) + I_2R_2$

Malla 2

$\mathcal{E}_I = I_2(R_2+R_3) + I_1R_2$

Malla 3

$\mathcal{E}_I = I_3R_4$

Cuarta ecuación

$I_2 + I_3 = 0.002A$

$$\begin{cases} 0 = 8000I_1 + 2000I_2 \\ \mathcal{E}_I = 5000I_2 + 2000I_1 \\ \mathcal{E}_I = 3000I_3 \\ I_2 + I_3 = 0.002 \end{cases}$$

$I_1 = -0.0002A$

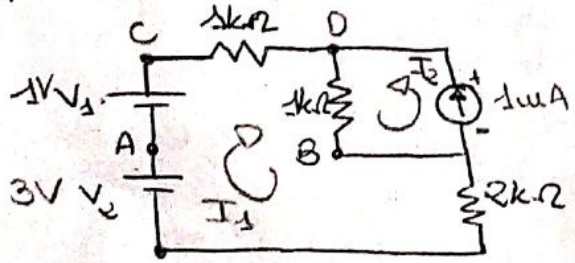
$I_2 = 0.0008A$

$I_0^2 = 0.0008 - 0.0002 = 0.0006\ (\downarrow)$

$I_0 = I_0^1 + I_0^2 = 0.0012A$

14. Relación

* Solo el equivalente Thevenin y Norton.



Malla 1

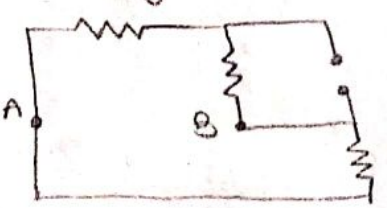
$V_1 + V_2 = I_1(1+1+2)\cdot 1000 + I_2 \cdot 1000$

Malla 2

$\mathcal{E}_I = 1000I_2 + 1000 \cdot I_1$

Cálculo R_{th}

Anulo fuentes:



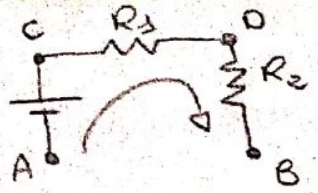
$R_{th} = R_1+R_2+R_3 = 4000\Omega$

$$\begin{cases} 4 = 4000I_1 + 1000I_2 \\ \mathcal{E}_I = 1000I_2 + 1000I_1 \\ I_2 = 0.001A \end{cases}$$

$I_1 = 0.00075A$

$I_2 = 0.001A$

$\mathcal{E}_I = 1.75V$



¿$V_A - V_B$?

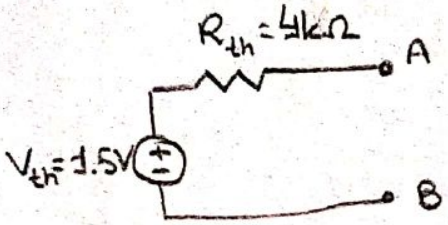
$V_C - V_A = 1V$

$V_C - V_D = I_1 R_1 \Rightarrow V_D - V_C = 0.00075 \cdot 1000 = 0.75V$

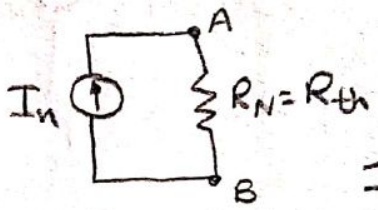
$V_D - V_B = (I_1 + I_2) R_2 = 1.75V$

$V_C - V_A - (V_C - V_D) = -V_A + V_D = 0.25V$

$V_D - V_B - (-V_A + V_D) = V_A - V_B = 1.5V \Rightarrow V_{th} = 1.5V$



Equivalente Thevenin

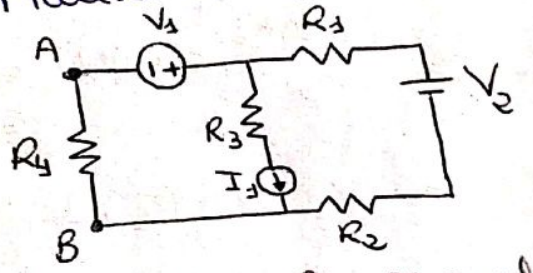


Equivalente Norton

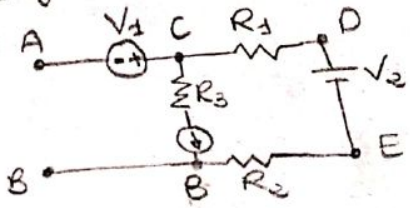
$$I_n = \frac{V_{th}}{R_{th}} = \frac{1.5V}{4000\Omega} = 0.000375A$$

Ejemplo Pág. 31

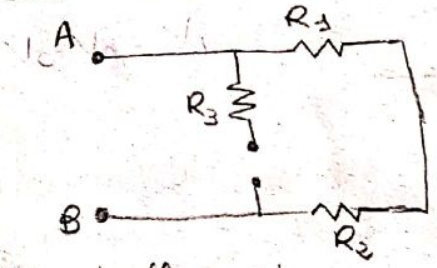
Hallar el equivalente Thevenin y Norton.



Dejamos abierto el camino entre A y B:

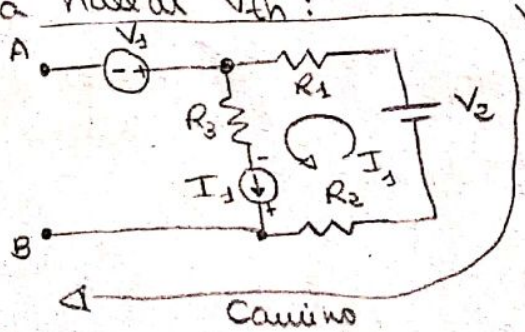


Para hallar R_{th}, se anulan las fuentes:



$R_{th} = R_1 + R_2$

Para hallar V_{th}:

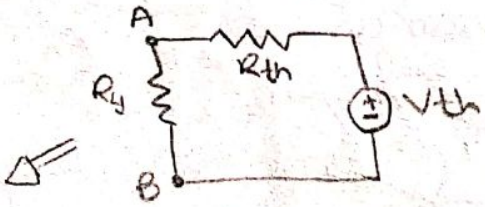


Malla 1

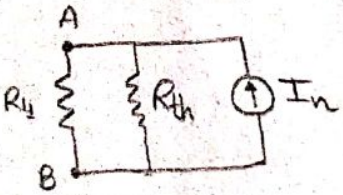
$$\left.\begin{array}{l} V_2 + \mathcal{E}_I = I_1 (R_1 + R_2 + R_3) \\ I_1 = I \end{array}\right\} \Rightarrow \mathcal{E}_I = I(R_1 + R_2 + R_3) - V_2$$

$V_A + V_1 + I_1 R_1 - V_2 + I_1 R_2 = V_B$

$V_A - V_B = V_2 - V_1 - I_1 R_1 - I_1 R_2 = V_{th}$

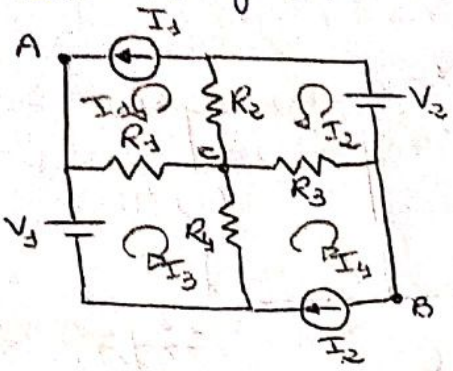


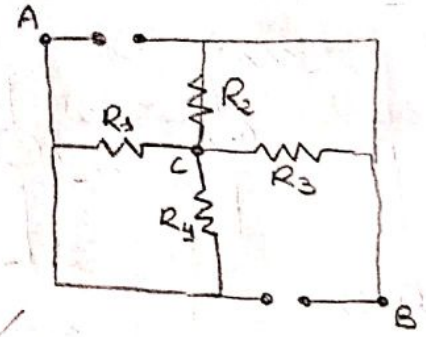
Equivalente Thevenin

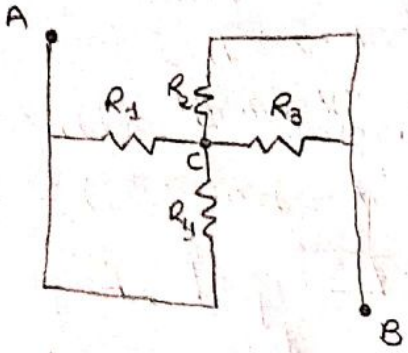


13. Relación

d) Calcular los equivalentes Thevenin y Norton del circuito entre A y B. Para calcular Rth, anulamos las fuentes:

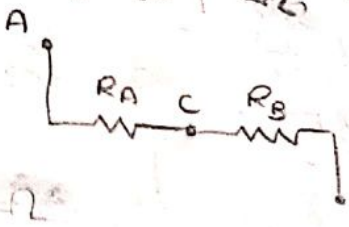






R_1 y R_4 están en paralelo.
R_2 y R_3 también lo están

$$R_A = \frac{R_1 R_4}{R_1 + R_4} = 3000\,\Omega \qquad R_B = \frac{R_2 R_3}{R_2 + R_3} = 5000\,\Omega$$



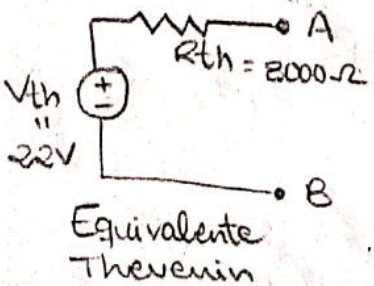
R_A y R_B están en serie

$$R_{th} = R_A + R_B = 8000\,\Omega$$

Para calcular V_{th}:
Ya tengo el circuito resuelto de antes:

$$V_A - \mathcal{E}_{I_1} - V_2 = V_B \Rightarrow V_A - V_B = \mathcal{E}_{I_1} + V_2 = V_{th}$$

(He tomado el camino) $16 + 6 = 22V$

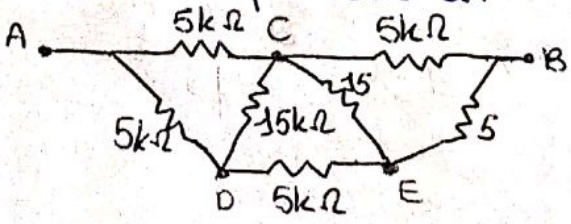


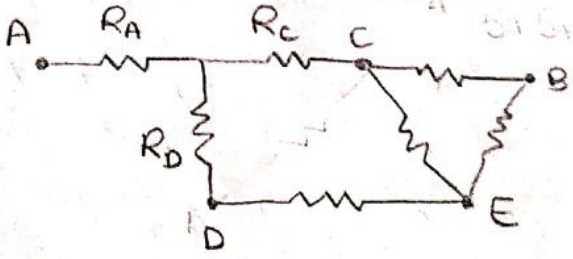
Equivalente Thevenin

$$I_N = \frac{V_{th}}{R_{th}} = \frac{22V}{8000\,\Omega} = 0.00275A$$

Problema 1 - Libro

Solo el apartado a.



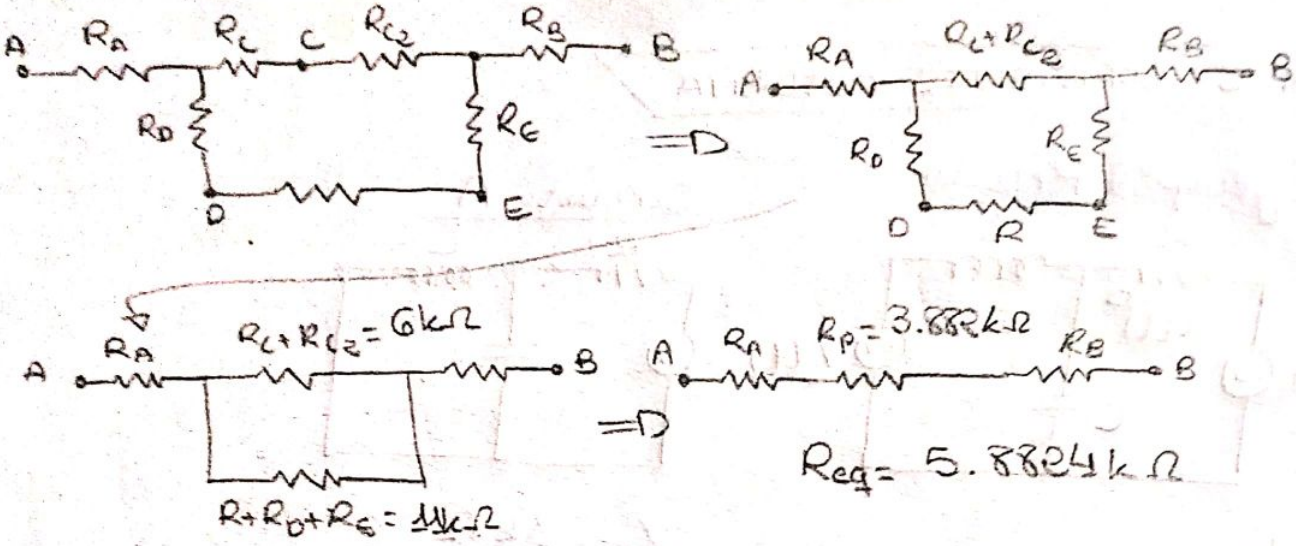


$$R_A = \frac{5 \cdot 5}{5+5+15} = 1k\Omega$$

$$R_D = 3k\Omega$$

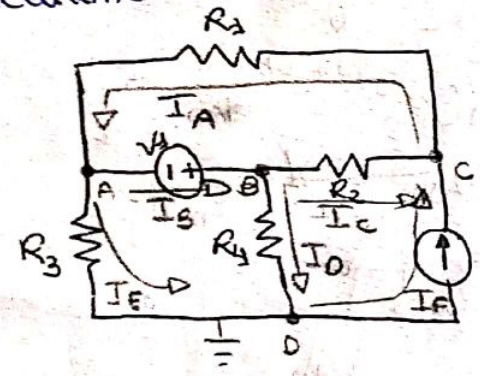
$$R_C = \frac{5 \cdot 15}{25} = 3k\Omega$$

$R_{C_2} = 3k\Omega$ $R_E = 3k\Omega$ $R_B = 1k\Omega$



21. Libro

Mediante el método de nudos, obtener la $\mathcal{E}_I$.



Datos

$\underbrace{R_1=R_2=R_3=R_4}_{6k\Omega}$

$V_1=12V$

$I_1=2mA$

Ley de nudos

A $I_A=I_B+I_E$

B $I_B=I_C+I_D$

C $I_C+I_F=I_A$

Cuarta ecuación: $V_B-V_A=12V$

$$\begin{cases} \frac{c-a}{6}=x+\frac{a}{6} \Rightarrow 6x=c-2a \\ x=\frac{b-c}{6}+\frac{b}{6} \Rightarrow 6x=2b-c \\ \frac{b-c}{6}+2=\frac{c-a}{6} \Rightarrow b-2c+a=-12 \\ b-a=12 \end{cases}$$

$I_A=\frac{V_C-V_A}{R_1}$ $I_E=\frac{V_B-V_C}{R_2}$ $I_D=\frac{V_B}{R_4}$ $I_E=\frac{V_A}{R_3}$ $I_F=2mA$

$a=0V$ $b=12V$ $c=12V$ $x=I_B=0.002A$

$$\mathcal{E}_I=V_C-\cancel{V_D}^{0}=V_C=12V$$