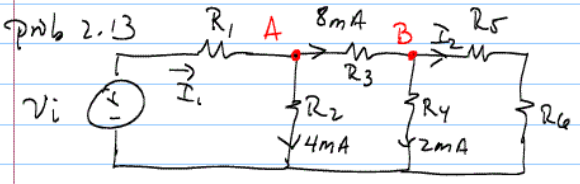
INEL 3105 3rd lecture.

Note Title 8/18/2009

Uso de diferentes técnicas de análisis de circuitos:

Prob 2.13



Encuentre las corrientes I_1 e I_2

KCL@ A:

$I_1 - 8mA - 4mA = 0$

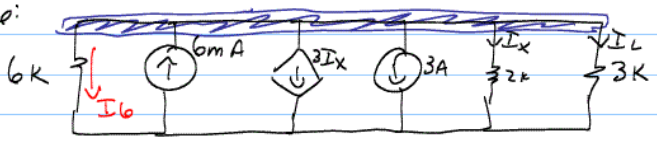
$\boxed{I_1 = 12mA}$

KCL@ B:

$8mA - 2mA - I_2 = 0$

$\boxed{I_2 = 6mA}$

2.16: Find all the currents.



KCL:

$6mA - 3I_x - 3A - I_x - I_L - I_6 = 0$

$3mA - 4I_x - I_L - I_6 = 0$

Todos los dispositivos están en paralelo ∴ todos los voltajes son iguales

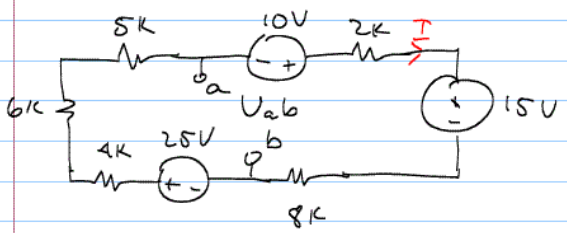
$V = I_6(6K) = I_x(2K) = I_L(3K)$

Re-writing KCL: $3mA - 4\underbrace{\left(\frac{1}{2K}\right)V}_{I_x} - \underbrace{\left(\frac{1}{3K}\right)V}_{I_L} - \underbrace{\left(\frac{1}{6K}\right)V}_{I_6} = 0$

$V = \frac{3mA}{.0025} = 1.2$

$I_6 = \frac{1.2}{6K} = 0.2mA$; $I_L = \frac{1.2}{3K} = .4mA$; $I_x = \frac{1.2}{2K} = .6mA$

Prob. 2.34 Find V_{ab}.



V_{ab} = ? Suma voltajes de "a" a "b"

$10V - 2K\,I - 15V - 8K\,I = V_{ab}$

I = ?

Suma de voltajes en el lazo = 0

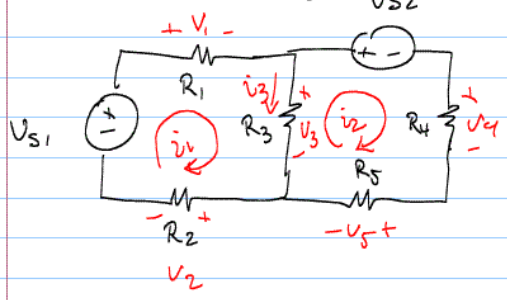
$10 - 2K\,I - 15V - 8K\,I + 25 - 4K\,I - 6K\,I - 5K\,I = 0$

$I\,(2K + 8K + 4K + 6K + 5K) = 20$

$I = \frac{20}{25K} = 0.8\,mA$; $V_{ab} = -13V$

$V_{ba} = 13V$

Análisis de Mallas:



Step 1 : Identificar mallas

Step 2: Label all currents

$i_3 = i_1 - i_2$

Step 3: Apply KVL

KVL @ i_1 :

$-V_1 - V_3 - V_2 + V_{S1} = 0$

KVL @ i_2

$-V_{S2} - V_4 - V_5 + V_3 = 0$

Step 4: Solve equations:

$V_1 = i_1 R_1$; $V_2 = i_1 R_2$; $V_3 = (i_1 - i_2) R_3$, $V_4 = i_2 R_4$, $V_5 = i_2 R_5$

Re-writing KVL's:

$$-i_1R_1 - (i_1 - i_2)R_3 - i_1R_2 + V_{S1} = 0$$

$$-V_{S2} - i_2R_4 - i_2R_5 + (i_1 - i_2)R_3 = 0$$

Combining terms

$$i_1(-R_1 - R_3 - R_2) + i_2(R_3) = -V_{S1}$$

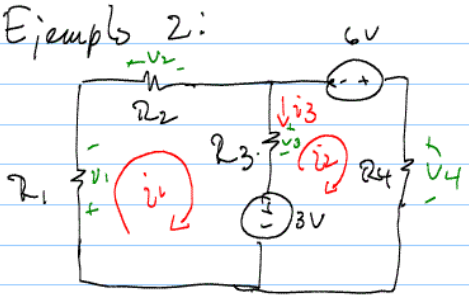
$$i_1(R_3) + i_2(-R_4 - R_5 - R_3) = V_{S2}$$

Re-writing in matrix form.

$$\underset{2\times 2}{\begin{bmatrix} -R_1 - R_3 - R_2 & R_3 \\ R_3 & -R_3 - R_4 - R_5 \end{bmatrix}} \underset{2\times 1}{\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}} = \underset{2\times 1}{\begin{bmatrix} -V_{S1} \\ V_{S2} \end{bmatrix}}$$

Step 5: Solve... enjoy :)

Ejemplo 2:



Step 1: Identificar mallas

Step 2: Label all currents

$i_3 = i_1 - i_2$

Step 3: Apply KVL

KVL @ i_1

$$-V_1 - V_2 - V_3 - 3V = 0$$

KVL @ i_2

$$3V + V_3 + 6V - V_4 = 0$$

Step 4: Solve equations

Re-write by KVL's

$i_1 R_1 - i_1 R_2 - (i_1 - i_2) R_3 - 3 = 0$ | $3V + (i_1 - i_2) R_3 + 6V - i_2 R_4 = 0$

Combining terms:

$i_1(-R_1 - R_3 - R_2) + i_2 R_3 = 3$ | $i_1(R_3) + i_2(-R_3 - R_4) = -9\,V$

Write in matrix form:

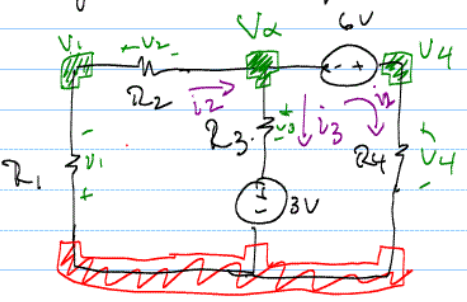
$$\begin{bmatrix} -R_1 - R_3 - R_2 & -R_2 + R_3 \\ R_3 & -R_3 - R_4 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 3 \\ -9 \end{bmatrix}$$

Step 5: Solve equations and enjoy :)

Assume $R_1 = 2K$, $R_2 = 4K$; $R_3 = 2K$; $R_4 = 6K$

find i_1, i_2, V_{6K}, V_{4K} ; $i_1 = -.1mA$, $i_2 = 1.1mA$, $V_{6K} = 6K(i_2) = 6.6V$

Solving the same problem by nodes:



Step 1: Choose ground

Step 2: Label All voltages:

V_α, V_1, V_4

Step 3: KCL's

$i_2 - i_3 - i_1 = 0$

$i_2 = \frac{V_1 - V_\alpha}{R_2}$; $i_3 = \frac{V_\alpha - 3}{R_3}$; $i_1 = \frac{V_4 - 0}{R_4}$

Re-writing KCL's

$\frac{V_1 - V_\alpha}{R_2} - \frac{V_\alpha - 3}{R_3} - \frac{V_4}{R_4} = 0$; NOOooo!! Solo 1 ecuación y 3 desconocidos!! :(

Ecuaciones auxiliares:

$V_4 - V_\alpha = 6V$; $i_2 = \frac{0 - V_1}{R_1} = \frac{V_1 - V_\alpha}{R_2}$; $-V_1 \frac{R_2}{R_1} = V_1 - V_\alpha$

$V_1\left(1 + \frac{R_2}{R_1}\right) - V_\alpha = 0$

Combining terms:

$V_1\left(\frac{1}{R_2}\right) + V_\alpha\left(\frac{-1}{R_2} - \frac{1}{R_3}\right) + V_4\left(\frac{-1}{R_4}\right) = \frac{-3}{R_3}$

$V_1(0) + V_\alpha(-1) + V_4(1) = 6$

$V_1\left(1 + \frac{R_2}{R_1}\right) + V_\alpha(-1) + V_4(0) = 0$

Writing in matrix form:

$$\begin{bmatrix} \frac{1}{R_2} & \frac{-1}{R_2} - \frac{1}{R_3} & \frac{-1}{R_4} \\ 0 & -1 & 1 \\ 1 + \frac{R_2}{R_1} & -1 & 0 \end{bmatrix} \begin{bmatrix} V_1 \\ V_\alpha \\ V_4 \end{bmatrix} = \begin{bmatrix} \frac{-3}{R_3} \\ 6 \\ 0 \end{bmatrix}$$

$V_1 = .2V$; $V_\alpha = .6V$; $V_4 = 6.6V$