blemas:

Ecuaciones simultaneas en el analisis de circuitos:

①.- Con el metodo de sustitucion, resuelva el siguiente conjunto de ecuaciones para I_{R1} e I_{R2}.

$100I_1 + 50I_2 = 30$

$75I_1 + 90I_2 = 15$

Entonces:

$$I_1 = \frac{30 - 50I_2}{100}$$

$$I_1 = \frac{3 - 5I_2}{10} = \frac{3}{10} - \frac{I_2}{2} = I_1$$

$75I_1 + 90I_2 = 15$

$$75\left(\frac{3 - 5I_2}{10}\right) + 90I_2 = 15$$

$75(3 - 5I_2) + 900I_2 = 150$

$225 - 375I_2 + 900I_2 = 150$

$525I_2 = 150 - 225$

$$I_2 = \frac{-75}{525} = \frac{-1}{7}\ A$$

Si $I_2 = -1/7$

Entonces:

$$I_1 = \frac{3 - 5\left(\frac{-1}{7}\right)}{10}$$

$$I_1 = \frac{21 + 5}{70}$$

$$I_1 = \frac{26}{70} = \frac{13}{35}\ A.$$

Entonces:

5.6 $\begin{cases} I_1 = -1/7 \\ I_2 = 13/35 \end{cases}$

②.- Evalue cada determinante:

a).- $\begin{vmatrix} 4 & 6 \\ 2 & 3 \end{vmatrix} = (3)(4) - (6)(2)$

$= 12 - 12$

$= 0\ \Omega$

b).- $\begin{vmatrix} 9 & -1 \\ 0 & 5 \end{vmatrix} = 9(5) + (1)(0)$

$= 45 + 0$

$= 45\ \Omega$

c).- $\begin{vmatrix} 12 & 15 \\ -2 & -1 \end{vmatrix} = (-1)(12) - (-2)(15)$

$= -12 + 30$

$= 18\ \Omega$

d).- $\begin{vmatrix} 100 & 50 \\ 30 & -20 \end{vmatrix} = (-20)(100) - (50)(30)$

$= -2000 - 1500$

$= -3500\ \Omega$

③.- Utilizando determinante, resuelva el siguiente conjunto de ec... para ambas corrientes:

$$-I_1 + 2I_2 = 4$$
$$7I_1 + 3I_2 = 6$$

En $I_1 \Rightarrow$

$$\frac{\begin{vmatrix} 4 & 2 \\ 6 & 3 \end{vmatrix}}{-17} = \frac{12 - 2(6)}{-17} = \frac{12-12}{-17} = 0 \Rightarrow I_1.$$

$$I_1 = 0.$$

Entonces:

$$\begin{vmatrix} -1 & 2 \\ 7 & 3 \end{vmatrix} = -3 - (2)(7)$$
$$= -3 - 14$$
$$= -17_{11}$$

En I_2

$$\frac{\begin{vmatrix} -1 & 4 \\ 7 & 6 \end{vmatrix}}{-17} = \frac{-6 - 7(4)}{-17} = \frac{-6-28}{-17} = \frac{-34}{-17} = \frac{34}{17} = 2_{11}$$

④.- Evalue cada uno de los determinantes.

⑨.-
$$\begin{vmatrix} 1 & 0 & -2 \\ 5 & 4 & 1 \\ 2 & 10 & 0 \end{vmatrix}$$

⇓

Entonces:

$$\begin{vmatrix} 1 & 0 & -2 \\ 5 & 4 & 1 \\ 2 & 10 & 0 \end{vmatrix} = \left[(4)(0) - 10(1)\right] - 5\left[0(0) + 10(2)\right] + 2\left[0(1) + 2(4)\right]$$

$$= (0 - 10) - 5(0 + 20) + 2(0 + 8)$$

$$= -10 - 5(20) + 2(8)$$

$$= -10 - 100 + 16$$

$$= -110 + 16 \Rightarrow -94_{11}$$

⇒

$$\begin{vmatrix} 0,5 & 1 & -0,8 \\ 0,1 & 1,2 & 1,5 \\ -0,1 & -0,3 & 5 \end{vmatrix} = 0,5\Big((1,2)(5)-(0,3)(1,5)\Big) - 0,1\Big(1(5)-(-0,8)(-0,3)\Big)$$

$$+(-0,1)\Big(1(1,5)-(-0,8)(1,2)\Big)$$

$$= 0,5\Big(6+0,45\Big) - 0,1\Big(5-0,24\Big) - 0,1\Big(1,5+0,96\Big)$$

$$= 0,5(6,45) - 0,1(4,76) - 0,1(2,46)$$

$$= 3,225 - 0,476 - 0,246$$

$$= 2,503 \text{ u}$$

---

⑤.- Calcule cada una de los determinantes:

ⓐ.-
$$\begin{vmatrix} 25 & 0 & -20 \\ 10 & 12 & 5 \\ -8 & 30 & -16 \end{vmatrix} = 25\Big(12(-16)-5(30)\Big) - 0\Big(10(-16)-(-8)(5)\Big) + (-20)\Big(10(30)-(12)(-8)\Big)$$

(0)

$$= 25\Big(-192-150\Big) - 20\Big(300+96\Big)$$

$$= 25(-342) - 20(396)$$

$$= -8550 - 7920$$

$$= -16470 \text{ u}$$

ⓑ.-
$$\begin{vmatrix} 1,08 & 1,75 & 0,55 \\ 0 & 2,12 & -0,98 \\ 1 & 3,49 & -1,05 \end{vmatrix} = 1,08\Big(2,12(-1,05)-(-0,98)(3,49)\Big) - 0\Big((1,75)(-1,05)-(0,55)(3,49)\Big)$$

(0)

$$+1\Big(1,75(-0,98)-(0,55)(2,12)\Big)$$

$$= 1,08(1,1942) + (-2,8811)$$

$$= -1,591264 \text{ u}$$

⑥: Determine I_3 en el ejemplo 9-4:

$I_1 + I_2 = I_3$

$\frac{V_A - 30}{82} + \frac{V_A - 40}{68} = \frac{-V_A}{147}$

$\frac{V_A}{82} - \frac{V_A}{68} + \frac{V_A}{147} = \frac{40}{68} + \frac{30}{82}$

$V_A(0,0337) = \frac{665}{697}$

$V_A = 28,31\,V.$

Entonces:

$I_1 = \frac{V_A - 30}{82}$

$I_2 = \frac{V_A - 40}{68}$

$I_3 = \frac{-V_A}{147} \Rightarrow -192,58\,mA$

$I_3 = -192,58\,mA$ "

⑦- Resuelva para I_1, I_2, I_3, en el siguiente conjunto de ecuaciones con determinantes:

$2I_1 - 6I_2 + 10I_3 = 9$

$3I_1 + 7I_2 - 8I_3 = 3$

$10I_1 + 5I_2 - 12I_3 = 0$

$$I_1 = \frac{\begin{vmatrix} 9 & -6 & 10 \\ 3 & 7 & -8 \\ 0 & 5 & -12 \end{vmatrix}}{-374} = \frac{-462}{-374} = 1,235\,A$$

Entonces:

$$\begin{vmatrix} 2 & -6 & 10 \\ 3 & 7 & -8 \\ 10 & 5 & -12 \end{vmatrix} = 2(7(-12) - (-8)(5)) - 3(-6(-12) - 10(5)) + 10((-6)(-8) - (10)(7))$$

$$= 2(-44) - 3(22) + 10(-22)$$

$$= -374$$ "

Entonces:

$I_1 = 1,235\,A$

$I_2 = 2,053\,A$

$I_3 = 1,885\,A$ "

$$I_2 = \frac{\begin{vmatrix} 2 & 9 & 10 \\ 3 & 3 & -8 \\ 10 & 0 & -12 \end{vmatrix}}{-374} = \frac{-768}{-374} = 2,053\,A$$

$$I_3 = \frac{\begin{vmatrix} 2 & -6 & 9 \\ 3 & 7 & 3 \\ 10 & 5 & 0 \end{vmatrix}}{-374} = \frac{-705}{-374} = 1,885\,A$$ "

⑧- Determine V_1, V_2, V_3 y V_4, resolviendo el siguiente conjunto de ecuaciones con una calculadora:

$$\begin{cases} 16V_1 + 10V_2 - 8V_3 - 3V_4 = 15 \\ 2V_1 + 0V_2 + 5V_3 + 2V_4 = 0 \\ -7V_1 - 12V_2 + 0V_3 + 0V_4 = 9 \\ -V_1 + 20V_2 - 18V_3 + 0V_4 = 0 \end{cases}$$

$$\begin{cases} 16x_1 + 10x_2 + -8x_3 + -3x_4 = 15 \\ 2x_1 + 0x_2 + 5x_3 + 2x_4 = 0 \\ -7x_1 + -12x_2 + 0x_3 + 0x_4 = 9 \\ -1x_1 + 20x_2 + -18x_3 + 0x_4 = 0 \end{cases}$$

$$\begin{pmatrix} \boxed{16} & 10 & -8 & 15 \\ 2 & 0 & 5 & 0 \\ -7 & -12 & 0 & 9 \\ -1 & 20 & -18 & 0 \end{pmatrix} \sim \text{El elemento pivote: } p_1 = a_{1,1} = 16 \quad \frac{a_{1,1}a_{i,j} - a_{i,1}a_{1,j}}{p_0} \to a_{i,j}$$

$$\begin{pmatrix} 16 & 10 & -8 & 15 \\ 0 & \boxed{-20} & 96 & -30 \\ 0 & -122 & -56 & 249 \\ 0 & 330 & -296 & 15 \end{pmatrix} \sim \text{El elemento pivote: } p_2 = a_{2,2} = -20 \quad \frac{a_{2,2}a_{i,j} - a_{i,2}a_{2,j}}{p_1} \to a_{i,j}$$

$$\begin{pmatrix} -20 & 0 & -50 & 0 \\ 0 & -20 & 96 & -30 \\ 0 & 0 & \boxed{802} & -540 \\ 0 & 0 & -1610 & 600 \end{pmatrix} \sim \text{El elemento pivote: } p_3 = a_{3,3} = 802 \quad \frac{a_{3,3}a_{i,j} - a_{i,3}a_{3,j}}{p_2} \to a_{i,j}$$

$$\begin{pmatrix} 802 & 0 & 0 & 1350 \\ 0 & 802 & 0 & -1389 \\ 0 & 0 & 802 & -540 \\ 0 & 0 & 0 & \boxed{19410} \end{pmatrix} \sim \text{El elemento pivote: } p_4 = a_{4,4} = 19410 \quad \frac{a_{4,4}a_{i,j} - a_{i,4}a_{4,j}}{p_3} \to a_{i,j}$$

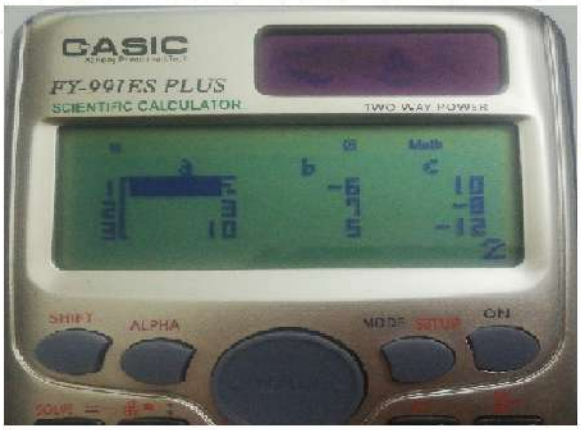
$$\begin{pmatrix} 19410 & 0 & 0 & 0 \\ 0 & 19410 & 0 & 0 \\ 0 & 0 & 19410 & 0 \\ 0 & 0 & 0 & 19410 \end{pmatrix}$$

$$\begin{vmatrix} 16 & 10 & -8 & 15 \\ 2 & 0 & 5 & 0 \\ -7 & -12 & 0 & 9 \\ -1 & 20 & -18 & 0 \end{vmatrix} = 19410$$

$$X = \begin{pmatrix} \frac{477}{292} \\ \frac{-1939}{1168} \\ \frac{-579}{292} \\ \frac{1941}{584} \end{pmatrix}$$

⑨- Resuelva los dos ecuaciones simultaneas del problema 7 con su calculadora.

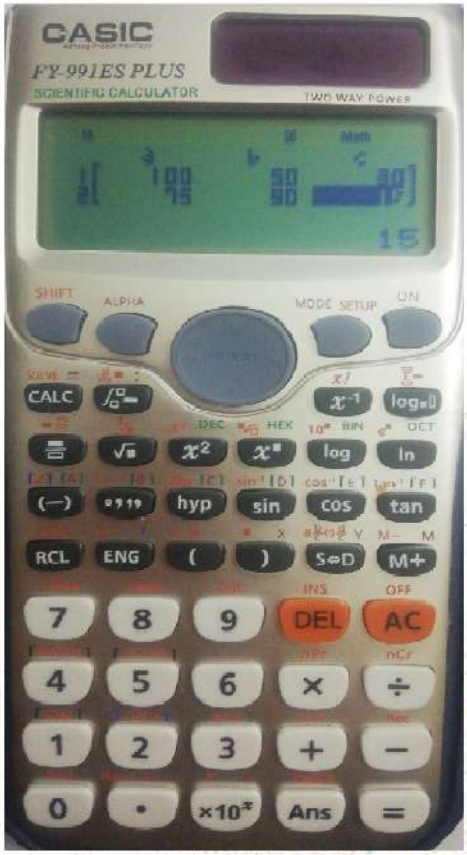
$$100 I_1 + 50 I_2 = 70$$
$$75 I_1 + 90 I_2 = 15$$



$$\begin{cases} I_1 = 0{,}37\ A \\ I_2 = -0{,}143\ A \end{cases}$$

⑩- Resuelva los tres corrientes simultaneas 7 con su calculadora.

$$2I_1 - 6I_2 + 10I_3 = 9$$
$$3I_1 + 7I_2 - 8I_3 = 3$$
$$10I_1 + 5I_2 - 12I_3 = 0$$

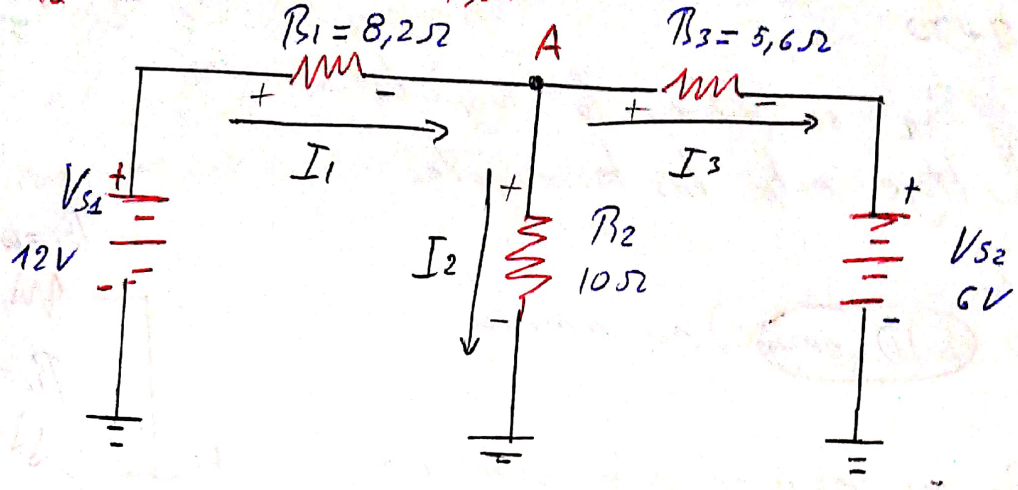


$I_1 = 1{,}235$

$I_2 = 2{,}053$

$I_3 = 1{,}88$

Metodo de la corriente en Ramas.



(11) Para nodo A

$I_1 = I_2 + I_3$ //

$-12V + 8,2I_1 + 10I_2 = 0$

$12V = 8,2I_1 + 10I_2$

$-6V - 5,6I_3 + 10I_2 = 0$

$6V = 10I_2 - 5,6I_3$

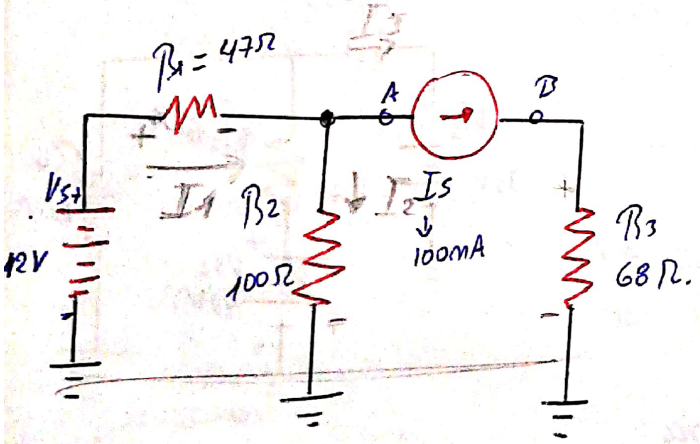
$$\begin{cases} I_1 - I_2 - I_3 = 0 \\ 8,2I_1 + 10I_2 = 12 \\ 10I_2 - 5,6I_3 = 6. \end{cases}$$

(12)

$$\begin{cases} I_1 = \frac{1590}{2299} = 0,692A \\ I_2 = \frac{1455}{2299} = 0,633A \\ I_3 = \frac{135}{2299} = 0,058A \text{ //} \end{cases}$$

(13).

$$\begin{cases} V_{R1} = 5,67V \\ V_{R2} = 6,33V \\ V_{R3} = 0,33V. \end{cases}$$



Entonces:

$I_1 = I_2 + I_3 + 100mA$

$I_1 = I_2 + I_3 + 0,1A.$

$I_1 - I_2 - I_3 = 0,1A. \Rightarrow$ 1ra Ecuacion

$12V = 47I_1 + 100I_2$

$47I_1 + 100I_2 = 12 \Rightarrow$ 2da Ecua.

$68(I_3 + 0,1) - 100(I_2) = 0$

$6,8 = 100I_2 - 68I_3$

3ra Ecua ⟸

Entonces:

$I_1 = I_2 + I_s$; $12V = 47I_1 + 100I_2$.

I_s ↓ 100mA

$I_1 - I_2 = 100mA$

$I_1 - I_2 = 0,1A$

$$\begin{cases} 47I_1 + 100I_2 = 12 \\ I_1 - I_2 = 0,1 \end{cases}$$

Entonces

$$\begin{cases} I_1 - I_2 - I_3 = 0,1A \\ 47I_1 + 100I_2 = 12 \\ 100I_2 - 68I_3 = 6,8 \end{cases} \Rightarrow$$

Entonces

(14)
$$\begin{cases} I_1 = \frac{252}{1837} = 0,137A \\ I_2 = \frac{102}{1837} = 0,055A \\ I_3 = \frac{-337}{18370} = -0,018A_{//} \end{cases}$$

(15)
$$\begin{cases} (68)(-0,018) = -1,224\ V_{//} \end{cases}$$

Metodo de corrientes en lazos.

(16)

$$0,045I_A + 0,130I_B + 0,066I_C = 0$$

$$0,177I_A + 0,0420I_B + 0,109I_C = 12$$

$$0,078I_A + 0,196I_B + 0,029I_C = 3$$

$$\begin{vmatrix} 0,045 & 0,130 & 0,066 \\ 0,177 & 0,0420 & 0,109 \\ 0,078 & 0,196 & 0,029 \end{vmatrix} = 1,604856 \times 10^{-3}$$

$\Rightarrow$ ⇓

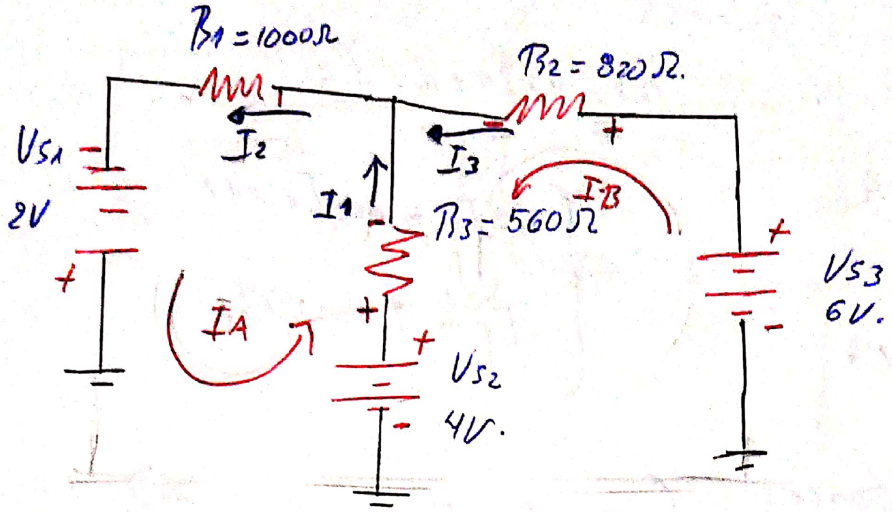
$\Rightarrow 1,60mA_{//}$

Entonces:

$$I_A = \frac{\begin{vmatrix} 0 & 0,130 & 0,066 \\ 12 & 0,0420 & 0,109 \\ 3,0 & 0,196 & 0,029 \end{vmatrix}}{1,604856 \times 10^{-3}} = \frac{0,144186}{1,604856 \times 10^{-3}} = 89,84A. \Rightarrow I_{A//}$$

$$I_B = \frac{\begin{vmatrix} 0,045 & 0 & 0,066 \\ 0,177 & 12 & 0,109 \\ 0,078 & 3,0 & 0,029 \end{vmatrix}}{1,604856 \times 10^{-3}} = \frac{-0,025785}{1,604856 \times 10^{-3}} = -16,06A \Rightarrow I_{B//}$$

$$I_C = \frac{\begin{vmatrix} 0,045 & 0,130 & 0 \\ 0,177 & 0,0420 & 12 \\ 0,078 & 0,196 & 3,0 \end{vmatrix}}{1,604856 \times 10^{-3}} = \frac{-0,04752}{1,604858 \times 10^{-3}} = -29,61A = I_{C//}$$



$2V + 4V = (560 + 1000) I_A - 560 I_B$

$6V = 1560 I_A - 560 I_B$

$(6-4)V = (820 + 560) I_B - 560 I_A$

$2 = 1380 I_B - 560 I_A$

$$\begin{cases} 1560 I_A - 560 I_B = 6 \\ 560 I_A - 1380 I_B = -2 \end{cases}$$

$\Downarrow$

$I_A = 5,032\ mA$

$I_B = 3,491\ mA.$

$I_1 = 5,032 - 3,491$

$I_1 = 1,541\ mA.$

$$\begin{cases} I_3 = I_B = 3,491\ mA \\ I_2 = I_A = 5,032\ mA \end{cases}$$ (17)

(19.-)

$$\begin{cases} I_3 = I_B = 3,491\ mA \\ I_2 = I_A = 5,032\ mA \\ I_1 = 1,541\ mA \end{cases}$$

Entonces

$\Downarrow$

$V_{R_2} = (820)(3,491) = 2,86\ V.$

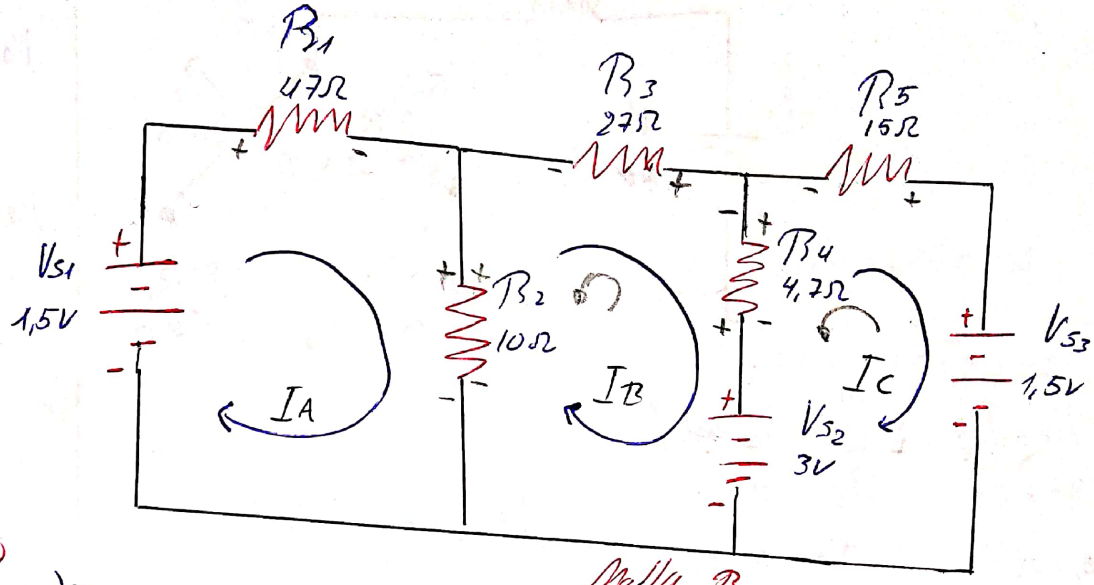
$V_{R_3} = (1,541)(560) = 0,863\ V.$

$V_{R_1} = (1000)(5,032) = 5,032\ V.$

(20).- Escriba las ecuaciones de lazo para el circuito de la fig 9-26

(21).- Resuelva para las corrientes de lazo en la fig- 9-29. con su calculadora

(22).- Determine la corriente a través de cada resistencia de la fig 9-29.



(20) Malla A

$-1,5 + (47+10)I_A + 10I_B = 0$

$1,5 = 57I_A + 10I_B$

Malla B

$-3 + (4,7+27+10)I_B + 10I_A - 4,7I_C = 0$

$3 = 41,7I_B + 10I_A - 4,7I_C$

$3 = 10I_A + 41,7I_B - 4,7I_C$

Malla C.

$-1,5 + 3 + (15+4,7)I_C - 4,7I_B = 0$

$1,5 = 4,7I_B - 19,7I_C$

(21)

$$\begin{cases} 57I_A + 10I_B = 1,5 \\ 4,7I_B - 19,7I_C = 1,5 \\ 10I_A + 41,7I_B - 4,7I_C = 3 \end{cases} \Rightarrow \begin{cases} I_A = 0,015565 = 15,56\,mA \\ I_B = 0,061275 = -61,275\,mA \\ I_C = -0,06152 = 61,52\,mA \end{cases}$$

(22).- $-I_{R1} = 15,56\,mA = I_A$

$-I_{R5} = I_C = 61,52\,mA.$

- $I_{R2} = 15,56 - (-61,275)$.

  $I_{R2} = 76,835\,mA$

- $I_B = I_{R3} = 15,56\,mA$

- $I_{R4} = -61,275 - 61,52$

  $I_{R4} = -122,795\,mA$

Entonces:

$I_{R1} = 15,56\,mA$

$I_{R2} = 76,83\,mA$

$I_{R3} = 15,56\,mA$

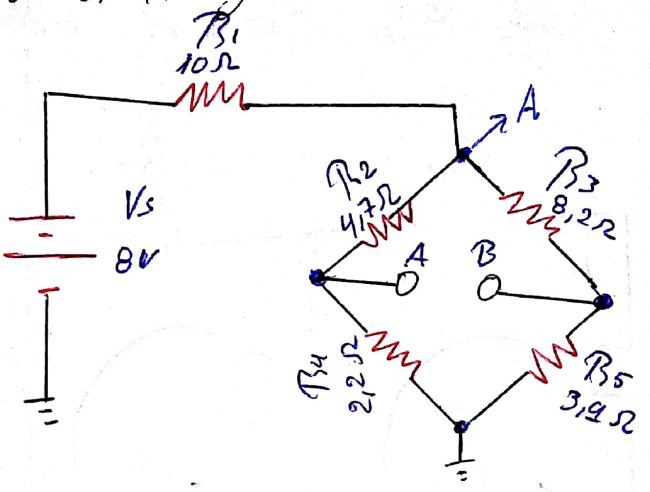
$I_{R4} = -122,795\,mA$

$I_{R5} = 61,52\,mA$

(23) Determine el voltaje entre los terminales del puente abierto, A y B en la fig 9-36

(24)- Cuando se conecta un resistor de 10 kΩ desde la terminal A hasta la terminal B en la fig 9-36 ¿Cuál es la corriente a través de él?

(25)- Escriba las ecuaciones de lazo en la forma estándar para el circuito puente T mostrado en la fig 9-30.



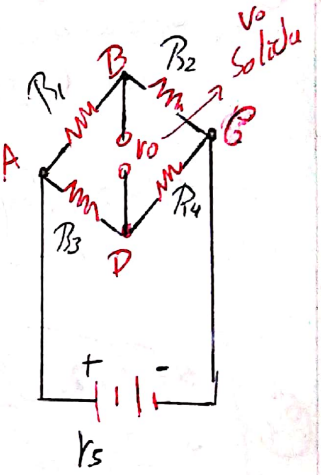
$V_o = V_{AB} - V_{AD}$

$V_{AB} = \frac{V_s R_1}{R_1 + R_2}$

$V_{AD} = \frac{V_s R_3}{R_3 + R_4}$

$V_o = V_{AB} - V_{AD}$

$= V_s \left(\frac{R_1}{R_1 + R_2} - \frac{R_3}{R_3 + R_4} \right)$



$R_A = R_2 + R_4$; $R_B = 8,2 + 3,9$

$R_A = 4,7 + 2,2$; $R_B = 12,1$

$R_A = 6,9\ \Omega$ $R_B = 12,1\ \Omega$

$V_{R1} = \left(\frac{V_T}{R_T} \right)(R_x)$

$V_{R_1} = \left(\frac{8}{14,39} \right)(10)$

$V_{R1} = 5,56\ V.$

$R_{AB} = \frac{1}{\frac{1}{6,9} + \frac{1}{12,1}} = 4,39\ \Omega$

$R_T = (4,39 + 10)\ \Omega$

$R_T = 14,39\ \Omega$

$V_{nodo\ A} = 8 - 5,56$

$V_{nodo\ A} = 2,44\ V$

Entonces

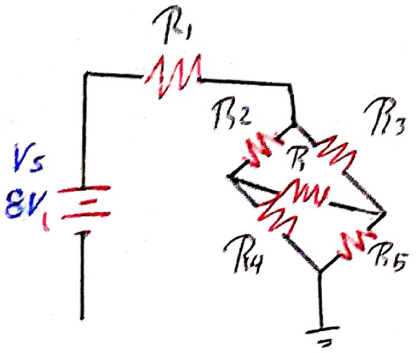
$V_{AB} = V_s \left(\frac{R_3}{R_3 + R_5} - \frac{R_2}{R_2 + R_4} \right)$

$V_{salida} = 2,44 \left(\frac{8,2}{8,2 + 3,9} - \frac{4,7}{4,7 + 2,2} \right)$

(23) $\Rightarrow V_{Salida} \approx -8,47\ mV$

Si $R_1 = 10\,K\Omega$

Entonces:



Datos

$R_{R1} = 10\,\Omega$

$R_2 = 4,7\,\Omega$

$R_3 = 8,2\,\Omega$

$R_{R4} = 2,2\,\Omega$

$R_5 = 3,9\,\Omega$

$R = 10\,K\Omega$.

$8 = (10 + 4,7 + 2,2)\,I_A + 4,7\,I_B - 2,2\,I_C$

$8 = 10,9\,I_A - 4,7\,I_B - 2,2\,I_C$

$(8,2 + 10000 + 4,7)\,I_B - 4,7\,I_A - 10000\,I_C = 0$

$10012,9\,I_B - 4,7\,I_A - 10000\,I_C = 0$

$(10000 + 3,9 + 2,2)\,I_C - 10000\,I_B - 2,2\,I_A = 0$

$10006,1\,I_C - 10000\,I_B - 2,2\,I_C = 0$

Entonces:

$I_A = 0,50\,A$

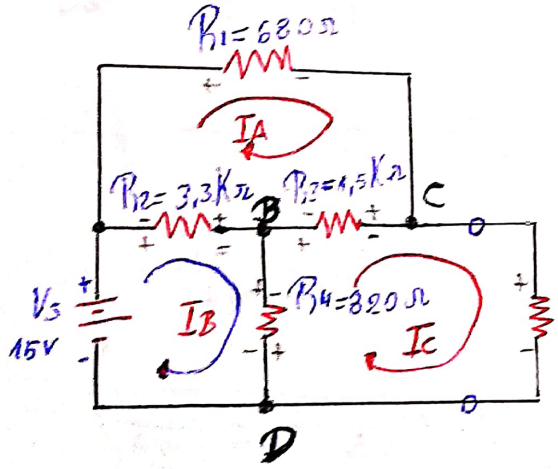
$I_B = 0,1816\,A$

$I_C = 0,1816\,A$

(24) $\{ I_B = 0,1816 - 0,1816 \simeq 0,7632\,mA$

---

(25).- Escriba las ecuaciones de lazo en la forma estandar para el circuito puente T mostrado en la Fig 9-31.



Datos:

$R_1 = 0,68\,K\Omega$

$R_2 = 3,3\,K\Omega$

$R_3 = 1,5\,K\Omega$

$R_4 = 0,82\,K\Omega$

$(0,68 + 1,5 + 3,3)\,I_A - 1,5\,I_C - 3,3\,I_B = 0$

1ra Ecu $\Rightarrow$ $5,48\,I_A - 1,5\,I_C - 3,3\,I_B = 0$

$-15 + (3,3 + 0,82)\,I_B - 3,3\,I_A - 0,82\,I_C = 0$

2da Ecua $\Rightarrow$ $15 = 4,12\,I_B - 3,3\,I_A - 0,82\,I_C$

$(2,2 + 0,82 + 1,5)\,I_C - 0,82\,I_B - 1,5\,I_A = 0$

3ra Ecu. $4,52\,I_C - 0,82\,I_B - 1,5\,I_A = 0$

En tonces

(25).- $\begin{cases} 5,48\,I_A - 1,5\,I_C - 3,3\,I_B = 0 \\ 4,12\,I_B - 3,3\,I_A - 0,82\,I_C = 15 \\ 4,52\,I_C - 0,82\,I_B - 1,5\,I_A = 0 \end{cases}$ $\longrightarrow$

Entonces:

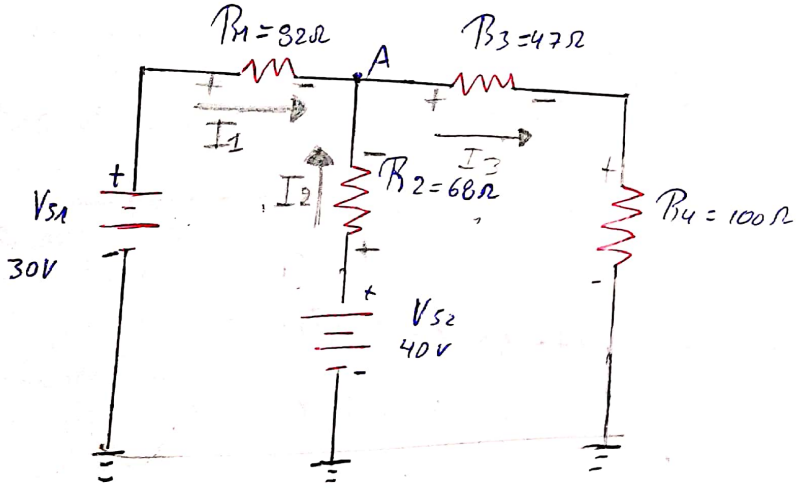
$$\begin{cases} 5{,}48 I_A - 3{,}3 I_B - 1{,}5 I_C = 0 \\ 3{,}3 I_A - 4{,}12 I_B + 0{,}82 I_C = -15 \\ 1{,}5 I_A + 0{,}82 I_B - 4{,}52 I_C = 0 \end{cases} \Rightarrow \begin{cases} I_A = 7{,}62\ mA \\ I_B = 10{,}64\ mA \\ I_C = 4{,}46\ mA \end{cases}$$

Metodo del voltaje en nodos:

(26).- En la fig 9-32, use el metodo del voltaje en nodos para determinar el voltaje presente en el punto A con respecto a la tierra.

(27).- ¿Cuales son los valores de corriente de rama en la fig. 9-32? En cada rama, muestre la direccion real de la corriente?

(28).- Escriba las ecuaciones de voltaje de nodo para la figura 9-29 Use su calculadora para determinar los voltajes de nodo.



$$I_1 + I_2 = I_3$$

$$\frac{V_A - 30}{82} + \frac{V_A - 40}{68} = \frac{-V_A}{147}$$

$$\frac{V_A}{82} - \frac{30}{82} + \frac{V_A}{68} - \frac{40}{68} = \frac{-V_A}{147}$$

$$\frac{V_A}{82} + \frac{V_A}{68} + \frac{V_A}{147} = \frac{40}{68} + \frac{30}{82}$$

$$V_A\left(\frac{1}{82} + \frac{1}{68} + \frac{1}{147}\right) = \frac{665}{697}$$

$$V_A = \left(\frac{665}{697}\right)\left(\frac{1}{\frac{1}{82} + \frac{1}{68} + \frac{1}{147}}\right)$$

$$I_1 = \frac{V_A - 30}{82} \qquad I_1 = \frac{V_A - 30}{82}$$

$$I_2 = \frac{V_A - 40}{68} \qquad I_2 = \frac{V_A - 40}{68}$$

$$I_3 = \frac{0 - V_A}{(47 + 100)} \qquad I_3 = \frac{-V_A}{147}$$

(26).- $V_A = 28{,}31\ V.$

→

$$\begin{cases} I_1 = \frac{V_A - 30}{82} \\ I_2 = \frac{V_A - 40}{68} \\ I_3 = \frac{-V_A}{147} \end{cases} \quad \text{Si } V_A = 28{,}31\,V$$

Entonces

$$\begin{cases} I_1 = \frac{28{,}31 - 30}{82} \\ I_2 = \frac{28{,}31 - 40}{68} \\ I_3 = \frac{-28{,}31}{147} \end{cases} \Rightarrow \begin{cases} I_1 = -20{,}61\,mA \\ I_2 = -171{,}91\,mA \\ I_3 = -192{,}58\,mA. \end{cases}$$

⇨ Entonces:

(27).- $\begin{cases} I_1 = -20{,}61\,mA \\ I_2 = -171{,}91\,mA \\ I_3 = -192{,}58\,mA \end{cases}$ ⟶

Entonces

- Su dirección es diferente. por el motivo que esta del signo negativo.

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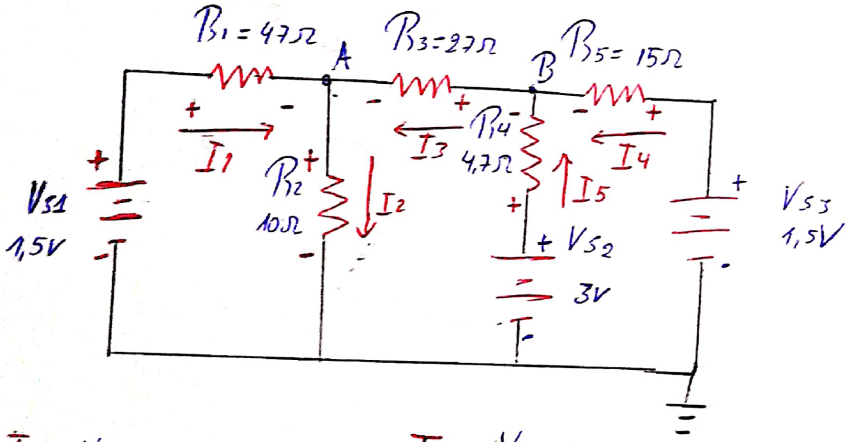
(28).- Escriba las ecuaciones de voltaje de nodo para la fig 9-29. Use su calculadora para determinar los voltajes de nodo.



$$I_1 = \frac{V_A - 1{,}5}{47} \qquad I_4 = \frac{V_B - 1{,}5}{15}$$

$$I_2 = \frac{-V_A}{10} \qquad I_5 = \frac{V_B - 3}{4{,}7}$$

$$I_3 = \frac{V_A - V_B}{27} \qquad I_4 + I_5 = I_3$$

$$I_1 + I_3 = I_2.$$

Entonces:

$$\frac{V_B - 1{,}5}{15} + \frac{V_B - 3}{4{,}7} = \frac{V_A - V_B}{27}$$

$$\frac{V_B}{15} - \frac{1{,}5}{15} + \frac{V_B}{4{,}7} - \frac{3}{4{,}7} = \frac{V_A}{27} - \frac{V_B}{27}$$

$$I_1 + I_3 = I_2.$$

$$\frac{V_A - 1{,}5}{10} + \frac{V_A - V_B}{27} = \frac{-V_A}{10}$$

$$\frac{V_A}{10} - \frac{1{,}5}{10} + \frac{V_A}{27} - \frac{V_B}{27} = \frac{-V_A}{10}$$

$$\frac{V_A}{10} + \frac{V_A}{27} + \frac{V_A}{10} - \frac{V_B}{27} = \frac{1{,}5}{10}$$

$$V_A\left(\frac{1}{10} + \frac{1}{27} + \frac{1}{10}\right) - \frac{V_B}{27} = \frac{1{,}5}{10}$$

$$V_A\left(\frac{32}{135}\right) - \frac{V_B}{27} = \frac{1{,}5}{10}$$

$$\frac{32}{135} V_A - \frac{V_B}{27} = \frac{1{,}5}{10}$$

⟹

$$\frac{32}{135}V_A - \frac{V_B}{27} = \frac{1,5}{10} \Rightarrow 1^{ra}\ Ecua.$$

$$\frac{V_B}{15} - \frac{1,5}{15} + \frac{V_B}{4,7} - \frac{3}{4,7} = \frac{V_A}{27} - \frac{V_B}{27}$$

$$\frac{V_B}{15} + \frac{V_B}{4,7} + \frac{V_B}{27} - \frac{V_A}{27} = \frac{3}{4,7} + \frac{1,5}{15}$$

$$V_B\left(\frac{1}{15} + \frac{1}{4,7} + \frac{1}{27}\right) - \frac{V_A}{27} = \frac{347}{470}$$

$$V_B\left(\frac{2008}{6345}\right) - \frac{V_A}{27} = \frac{347}{470}$$

→ Entonces:

$$\begin{cases} \frac{2008}{6345}V_B - \frac{V_A}{27} = \frac{347}{470} \\ \frac{32}{135}V_A - \frac{V_B}{27} = \frac{1,5}{10} \end{cases}$$

Finalmente:

(28)-

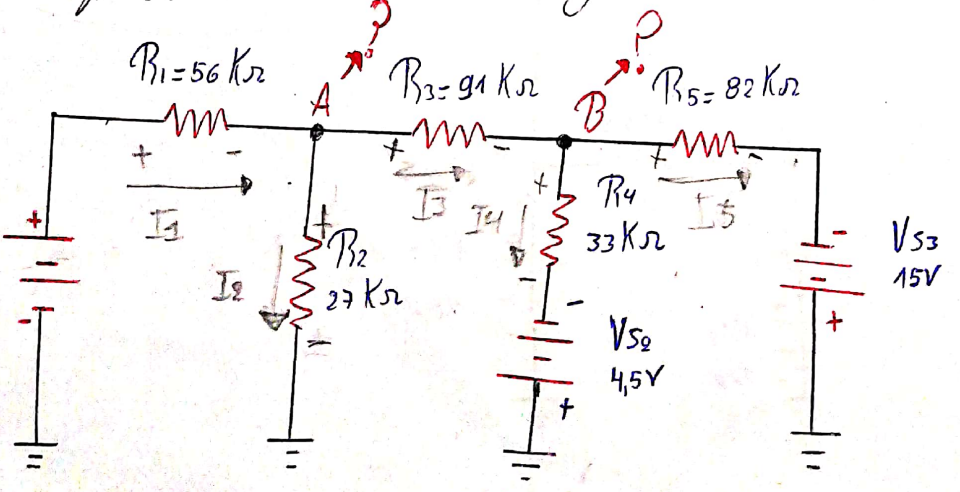
$$\begin{cases} \frac{2008}{6345}V_B - \frac{V_A}{27} = \frac{347}{470} \\ \frac{32}{135}V_A - \frac{V_B}{27} = \frac{1,5}{10} \end{cases}$$

Entonces:

$$\begin{cases} V_A = 1,016\ V \\ V_B = 2,45\ V. \end{cases}$$

---

(29).- Use el analisis de nodos para determinar el voltaje en los puntos A y B. con respecto a tierra en la fig. 9-33.



$$I_1 = \frac{9 - V_A}{56}$$

$$I_2 = \frac{V_A - 0}{27}$$

$$I_3 = \frac{V_A - V_B}{91}$$

$\Rightarrow$ $I_1 = I_2 + I_3$

$$\frac{9}{56} - \frac{V_A}{56} = \frac{V_A}{27} + \frac{V_A}{91} - \frac{V_B}{91}$$

$$\frac{V_A}{27} + \frac{V_A}{91} + \frac{V_A}{56} - \frac{V_B}{91} = \frac{9}{56}$$

$$0,066\, V_A - 0,011\, V_B = 0,16 \Rightarrow \text{1ra Ecuación}$$

$$I_3 = \frac{V_A - V_B}{91}$$

$$I_4 = \frac{V_B + 4,5}{33}$$

$$I_5 = \frac{V_B + 15}{82}$$

$$I_3 = I_4 + I_5$$

$$\frac{V_A}{91} - \frac{V_B}{91} = \frac{V_B}{33} + \frac{4,5}{33} + \frac{V_B}{82} + \frac{15}{82}$$

$$\frac{V_A}{91} - \frac{V_B}{91} - \frac{V_B}{33} - \frac{V_B}{82} = \frac{4,5}{33} + \frac{15}{82}$$

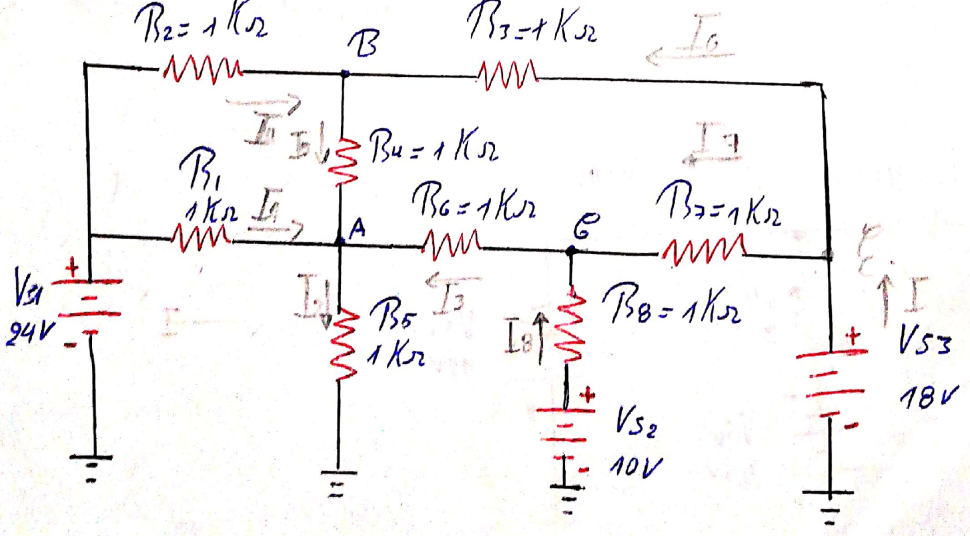
$$0,011 V_A - 0,053\, V_B = 0,32 \Rightarrow 2^{da} \text{ Ecuación:}$$

Entonces.

$$\begin{cases} 0,066\, V_A - 0,011\, V_B = 0,16 \\ 0,011\, V_A - 0,053\, V_B = 0,32 \end{cases} \Rightarrow \begin{cases} V_A = 1,46\, V \\ V_B = -5,73\, V \end{cases}$$

---

(30).- Determine el voltaje en los puntos A, B y C en la fig 9_34



$I_1 + I_5 + I_3 = I_2$

$I_1 = \frac{24 - V_A}{1}$

$I_5 = \frac{V_B - V_A}{1}$

$I_3 = \frac{V_C - V_A}{1}$

$I_2 = \frac{V_A - 0}{1}$

$24 - V_A + V_B - V_A + V_C - V_A = V_A$

$24 - V_A - V_A - V_A + V_B + V_C - V_A = 0$

$24 - 4V_A + V_B + V_C = 0$

$4V_A - V_B - V_C = 24 \Rightarrow 1^{ra}$ Ecua.

$I_4 + I_6 = I_5$

$I_4 = \frac{24 - V_B}{1}$

$I_6 = \frac{18 - V_B}{1}$

$I_5 = \frac{V_B - V_A}{1}$

$24 - V_B + 18 - V_B = V_B - V_A$

$48 - 2V_B - V_B + V_A = 0$

$48 - 3V_B + V_A = 0$

$V_A - 3V_B = -48 \Rightarrow 2^{da}$ Ecua.

$I_7 + I_8 = I_3$

$I_7 = \frac{18 - V_C}{1}$

$I_8 = \frac{10 - V_C}{1}$

$I_3 = \frac{V_C - V_A}{1}$

$18 - V_C + 10 - V_C = V_C - V_A$

$28 - 2V_C - V_C + V_A = 0$

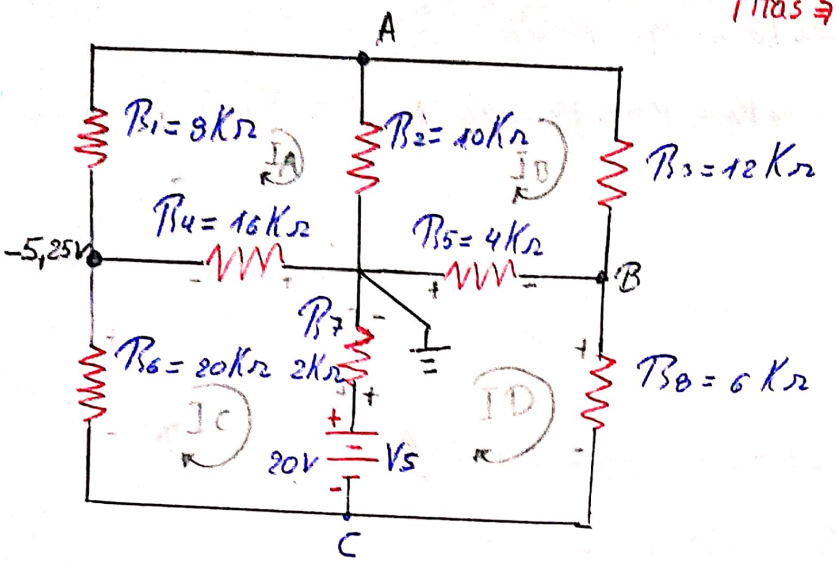
$V_A - 3V_C = -28 \rightarrow 3^{ra}$ Ecua.

Finalmente:

$$\begin{cases} 4V_A - V_B - V_C = 24 \\ V_A - 3V_B = -48 \\ V_A - 3V_C = -28 \end{cases} \overset{\text{SOL}}{\Rightarrow} \begin{cases} V_A = 14{,}8\,V \\ V_B = 20{,}93\,V \\ V_C = 14{,}26\,V \end{cases}$$

51).- Use el metodo o use el analisis de nodos, el de lazos, o cualquier otro procedimiento para determinar las corrientes y los voltajes en cada nodo desconocido en la fig 9-35.

Rtas ⇒ $I_1 = 193\,\mu A$; $I_2 = 370\,\mu A$
$I_3 = 179\,\mu A$; $I_4 = 328\,\mu A$
$I_5 = 1{,}46\,mA$; $I_6 = 522\,\mu A$
$I_7 = 2{,}16\,mA$; $I_8 = 1{,}64\,mA$
$V_A = -3{,}70\,V$; $V_B = -5{,}85\,V$;
$V_C = -15{,}7\,V$.



$(8+16+10)I_A - 10I_B - 16I_C = 0$
$34I_A - 10I_B - 16I_C = 0 \Rightarrow 1^{ra}$ Ecua.

$(10+12+4)I_B - 4I_D - 10I_A = 0$
$26I_B - 4I_D - 10I_A = 0$
$10I_A - 26I_B + 4I_D = 0 \Rightarrow 2^{da}$ Ecua.

$20 - (10+16+2)I_C + 16I_A + 2I_D = 0$
$20 = (38)I_C - 16I_A - 2I_D$
$16I_A - 38I_C + 2I_D = 20 \Rightarrow 3^{ra}$ Ecua.

$-20 + (2+4+6)I_D - 4I_B - 2I_C = 0$
$20 = 12I_D - 4I_B - 2I_C$
$4I_B + 2I_C - 12I_D = -20 \Rightarrow 4^{ta}$ Ecua.

Solucion General

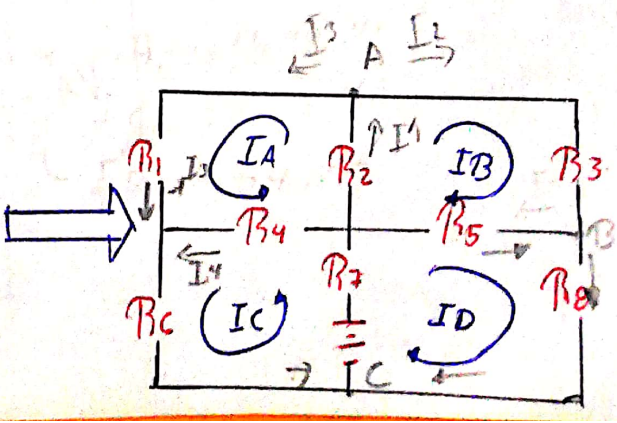
$$\begin{cases} 34I_A - 10I_B - 16I_C = 0 \\ 10I_A - 26I_B + 4I_D = 0 \\ 16I_A - 38I_C + 2I_D = 20 \\ 4I_B + 2I_C - 12I_D = -20 \end{cases}$$

$$\Downarrow$$

$$\begin{cases} I_A = -192{,}98\,\mu A \\ I_B = 177{,}94\,\mu A \\ I_C = -521{,}3\,\mu A \\ I_D = 1{,}64\,mA \end{cases} \Rightarrow$$

Entonces:

$$\begin{cases} I_A = 192{,}98\,\mu A \\ I_B = 177{,}94\,\mu A \\ I_C = 521{,}3\,\mu A \\ I_D = 1{,}64\,mA \end{cases}$$



$I_{R1} = 192,98\ \mu A$

$I_{R2} = 370,92\ \mu A$

$I_{R3} = 177,94\ \mu A$

$I_{R4} = (521,3 - 192,98)\ \mu A$

$I_{R4} = 329,3\ \mu A$

$I_{R5} = (1640 - 177,94)\ \mu A$

$I_{R5} = 1,462\ mA$

$I_{R6} = 521,3\ \mu A$

$I_{R7} = (521,3 + 1640)\ \mu A$

$I_{R7} = 2161,3\ \mu A \Rightarrow 2,16\ mA$

$I_{R8} = 1,64\ mA$

$\Rightarrow$

$I_{R1} = R_A = 192,98\ \mu A$

$I_{R2} = 370,92\ \mu A$

$I_{R3} = I_B = 177,32\ \mu A$

$I_{R4} = 328,32\ \mu A$

$I_{R5} = 1,462\ mA$

$I_{R6} = I_C = 521,3\ \mu A$

$I_{R7} = 2,16\ mA$

$I_{R8} = I_D = 1,64\ mA$

Ahora Buscamos los voltajes en cada nodo (A; B; C)

$I_1 = I_2 + I_3$

$$\frac{0 - V_A}{10} = \frac{V_A - V_B}{12} + \frac{V_A - (-5,25)}{8}$$

$$\frac{-V_A}{10} = \frac{V_A}{12} - \frac{V_B}{12} + \frac{V_A}{8} + \frac{5,25}{8}$$

$$\frac{V_A}{12} + \frac{V_A}{8} + \frac{V_A}{10} - \frac{V_B}{12} = -\frac{5,25}{8}$$

$$V_A(0,31) - 0,083\,V_B = -0,656$$

$$0,31\,V_A - 0,083\,V_B = -0,656 \Rightarrow 1^{ra}\ Ecuo.$$

$I_5 + I_8 = I_6$

$$\frac{-5,25 - V_C}{20} + \frac{V_B - V_C}{6} = \frac{V_C - (-20)}{2}$$

$$\frac{-5,25}{20} - \frac{V_C}{20} + \frac{V_B}{6} - \frac{V_C}{6} = \frac{V_C}{2} + \frac{20}{2}$$

$$\frac{-V_C}{20} - \frac{V_C}{6} - \frac{V_C}{2} + \frac{V_B}{6} = 10 + \frac{5,25}{20}$$

$$\left(\frac{-43}{60}\right)V_C + \frac{V_B}{6} = 10,26$$

$$0,16\,V_B - 0,72\,V_C = 10,26 \Rightarrow 2^{da}\ Ecuci.$$

$I_2 + I_7 = I_8$

$$\frac{V_A - V_B}{12} - \frac{V_B}{4} = \frac{V_B - V_C}{6}$$

$$\frac{V_A}{12} - \frac{V_B}{12} - \frac{V_B}{4} - \frac{V_B}{6} + \frac{V_C}{6} = 0$$

$$0,083\,V_A - 0,5\,V_B + 0,16\,V_C = 0$$

$\Downarrow$

$3^{ra}\ Ecua.$

$$\begin{cases} 0,31\,V_A - 0,083\,V_B = -0,656 \\ 0,16\,V_B - 0,72\,V_C = 10,26 \\ 0,083\,V_A - 0,5\,V_B + 0,16\,V_C = 0 \end{cases}$$

$\Downarrow$

Voltaje en cada nodo $\Rightarrow$

$$\begin{cases} V_A = -3,60\ V \\ V_B = -5,55\ V \\ V_C = -15,48\ V \end{cases}$$