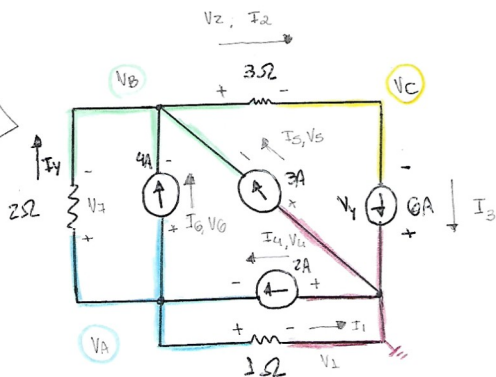


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• usando o algoritmo básico da análise nodal

→ 1) isolando cada um

$$VA) 2 = \frac{VA - VB + 8 + 2VA}{2}$$

$$4 = 3VA - VB + 8$$

$$3VA - VB = -4$$

$$VB) \frac{VA - VB + 8 + 6}{2} = \frac{VB - VC}{3}$$

$$\frac{VA - VB + 8 + 6}{2} - \frac{VB + VC}{3} = 0$$

$$\frac{3VA - 3VB + 24 + 18 - 2VB + 2VC}{6} = 0$$

$$\frac{3VA - 5VB + 2VC}{6} = -7$$

$$3VA - 5VB + 2VC = -42$$

$$VC) VB - VC = 18$$

3) sistema algébrico

$$\begin{cases} 3VA - VB = -4 \\ 3VA - 5VB + 2VC = -42 \\ VB - VC = 18 \end{cases}$$

• como $V_B = -V_C - 18$

$$\begin{aligned} VA &= -1 \\ VB &= 1 \\ VC &= -17 \end{aligned}$$

• como

$$I_4 = \frac{VA - VB}{2}$$

$$I_4 = \frac{-1 - 1}{2}$$

$$I_4 = -1A$$

1) definindo tensões nodais VA, VB, VC

$$VA) I_4 = I_7 + I_6 + I_1$$

$$VB) I_7 + I_6 + I_5 = I_2$$

$$VC) I_2 = I_3$$

mas $I_3 = 6A; I_4 = 2A; I_5 = 3A; I_6 = 4A$

então:

$$VA) 2 = I_7 + 4 + I_1$$

$$VB) I_7 + 4 + 3 = I_2$$

$$VC) I_2 = 6$$

2) definindo tensões sobre os resistores (Ohm)

$$I_1 = \frac{VA - 0}{1} = \frac{VA}{1} \Rightarrow I_1 = VA$$

$$I_2 = \frac{VB - VC}{3}$$

$$I_4 = \frac{VA - VB}{2}$$

3) derivar em função da tensão nodal

$$VA) 2 = \left(\frac{VA - VB}{2} \right) + 4 + VA$$

$$VB) \left(\frac{VA - VB}{2} \right) + 4 + 3 = \left(\frac{VB - VC}{3} \right)$$

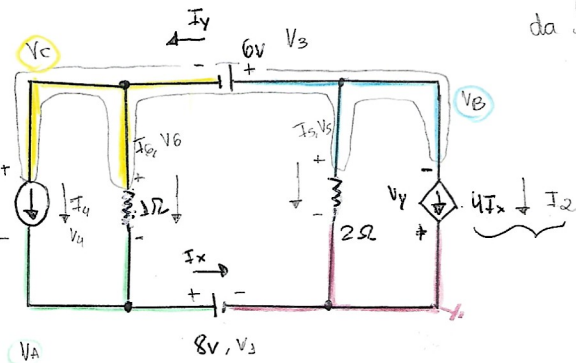
$$VC) \left(\frac{VB - VC}{3} \right) = 6$$

LCK em V_A

$$I_4 + I_6 = I_x$$

$$I_4 = 3$$

$$I_x = 3 + I_6$$



• algoritmo melhorado da análise nodal

temper: $V_A, V_C, V_B, V_3, V_4, V_5, V_6$

linhas nodais: V_A, V_B, V_C

correntes: $I_x, I_2, I_y, I_4, I_6, I_5$

2.c.1) o nó possui fonte conectada

2.c.2) $V_A - 0 = 8 \text{ (1)}$

2.c.3a) $V_B - V_C = 6 \text{ (2)}$

2.c.3b) $I_2 + I_5 + I_6 + I_4 = 0 \text{ (3)}$

resumindo

(1) $V_A = 8$

(2) $V_B - V_C = 6$

(3) $4(3 + I_6) + I_5 + I_6 + 3 = 0$

$\Rightarrow 4I_6 + I_5 + I_6 = -15$

$5I_6 + I_5 = -15$

correntes sobre resistores

$$I_5 = \frac{V_B - 0}{2} \Rightarrow \boxed{\frac{V_B}{2} = I_5}$$

$$\boxed{I_6 = V_C - V_A}$$

$V_A = 8$

$V_B - V_C = 6$

$5(V_C - V_A) + \frac{V_B}{2} = -15$

① $V_A = 8$

② $V_B - V_C = 6$

③ $5V_C - 5V_A + \frac{V_B}{2} = -15$

$V_A = 8 \parallel \quad V_B = 10 \parallel \quad V_C = 4 \parallel$

$V_y = -V_B + 0 =$

$\boxed{V_y = -30V}$

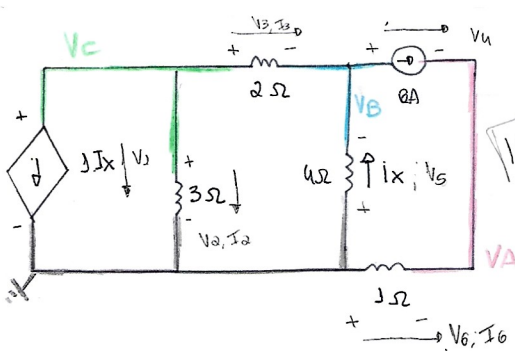
L.C.K. no nó V_C

$I_y = I_4 + I_6$

$I_y = 3 + V_C - V_A$

$I_y = 3 + 4 - 8$

$\boxed{I_y = -3A}$



$$I_x = \frac{0 - V_B}{4} = -\frac{V_B}{4}$$

$$I_6 = \frac{0 - V_A}{1} = -V_A$$

$$2a) I_x = \frac{0 - V_B}{4} = -\frac{V_B}{4}$$

$$V = R \cdot i$$

$$i = \frac{V}{R}$$

temperatura: $V_1, V_2, V_3, V_4, V_5, V_6$

corrente: $I_1, I_2, I_3, 6A, I_4, I_6$

temperatura mediana V_A, V_B, V_C

circ: corrente I_2, I_3, I_x, I_6
normal 2b

2c) LCK

$$V_A) I_6 + 6 = 0 \quad (1)$$

$$V_B) I_x + I_3 = 0 \quad (2)$$

$$V_C) I_x + I_2 + I_3 = 0 \quad (3)$$

2d)

$$I_3 = \frac{V_C - V_B}{2} \Rightarrow \frac{V_C}{2} - \frac{V_B}{2}$$

$$I_2 = \frac{V_C}{3}$$

$$(1) -V_A + 6 = 0$$

$$V_A = 6$$

$$(2) -\frac{V_B}{4} + \frac{V_C}{2} - \frac{V_B}{2} = 0$$

$$-\frac{V_B}{4} - \frac{2V_B}{2} + \frac{V_C}{2} = 0$$

$$-\frac{3V_B}{4} + \frac{V_C}{2} = 0 \quad (4)$$

$$\{-3V_B + 2V_C = 0 \quad (a) //$$

$$3) -\frac{V_B}{4} + \frac{V_C}{3} + \frac{V_C}{2} - \frac{V_B}{2} = 0$$

$$-\frac{V_B}{4} - \frac{2V_B}{2} + \frac{2V_C + 3V_C}{6} = 0$$

$$-\frac{3V_B}{4} + \frac{5V_C}{6} = 0 \quad (b)$$

$$\{-9V_B + 10V_C = 0 //$$

$$V_A = 6V$$

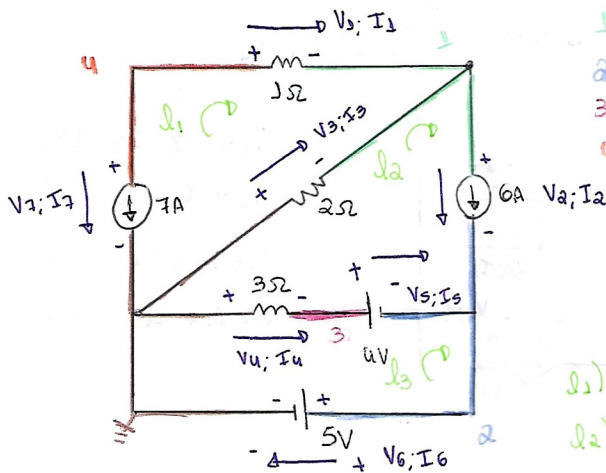
$$V_B = -20V$$

$$V_C = -18V$$

14/02 → EXERCÍCIO 1

lên 2b x 2b

aplicar LCK nos
(n-1) equações



$$\begin{aligned} 1 \bullet I_1 + I_3 &= I_2 & (8) \\ 2 \bullet I_2 + I_5 &= I_6 & (9) \\ 3 \bullet I_4 &= I_5 & (10) \\ 4 \bullet 0 &= I_1 + I_7 & (11) \end{aligned}$$

LCK nas malhas

$$\begin{aligned} l_1) +V_3 - V_3 - V_7 &= 0 & (12) \\ l_2) +V_2 - V_5 - V_4 + V_3 &= 0 & (13) \\ l_3) +V_6 + V_4 + V_5 &= 0 & (14) \end{aligned}$$

7 elementos, 14 equações

tensões: $V_1; V_2; V_3; V_4; V_5; V_6; V_7$

correntes: $I_1; I_2; I_3; I_4; I_5; I_6; I_7$

Equações características

$$V_1 = 1 \cdot I_1 \quad (V = R \cdot i) \quad (1)$$

$$I_2 = 6A \quad (2)$$

$$V_3 = 2 \cdot I_3 \quad (V = R \cdot i) \quad (3)$$

$$V_4 = 3 \cdot I_4 \quad (V = R \cdot i) \quad (4)$$

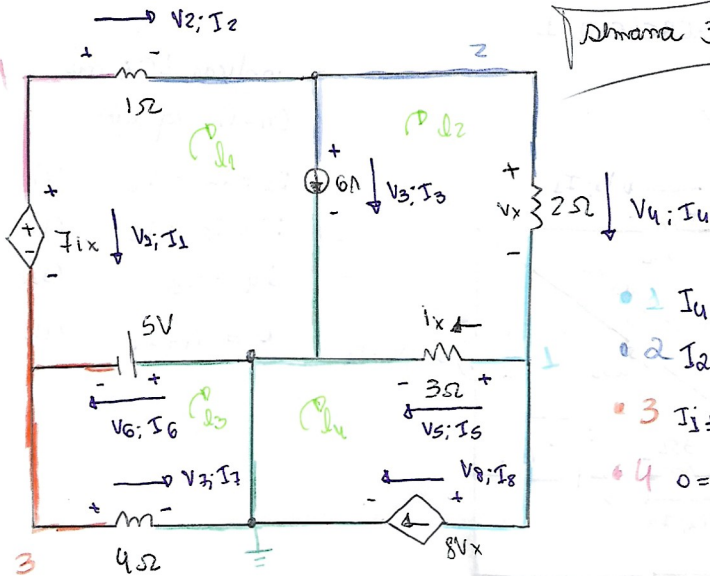
$$V_5 = 5V \quad 4V \quad (5)$$

$$V_6 = 5V \quad (6)$$

$$I_7 = 7A \quad (7)$$

14/02

Diagrama 3



LCK

$$1 \quad I_4 = I_9 + I_8 \quad (9)$$

$$2 \quad I_2 = I_3 + I_4 \quad (10)$$

$$3 \quad I_1 + I_6 = I_7 \quad (11)$$

$$4 \quad 0 = I_2 + I_1 \quad (12)$$

LTK

8 elementos, 10 eq.

tensiones: $V_1; V_2; V_3; V_4; V_5; V_6; V_7; V_8$

$I_1; I_2; I_3; I_4; I_5; I_6; I_7; I_8$

corrientes: $I_1; I_2; I_3; I_4; I_5; I_6; I_7; I_8$

$I_9; I_{10}; I_3; I_4; I_5; I_6; I_7; 8V_x$

$$i_x = I_5 \quad i_{10} = V_x$$

ecuaciones características

$$V_1 = I_1 \quad (1) \quad (\text{controlada})$$

$$V_2 = 2 \cdot I_2 \quad (2) \quad V = R \cdot i$$

$$I_3 = 6A \quad (3)$$

$$V_x = 2 \cdot I_4 \quad (4) \quad V = R \cdot i$$

$$V_5 = 3 \cdot i_x \quad (5) \quad V = R \cdot i$$

$$V_6 = 5V \quad (6)$$

$$V_7 = 4 \cdot I_7 \quad (7) \quad V = R \cdot i$$

$$I_8 = 8V_x \quad (8) \quad (\text{controlada})$$

14/02