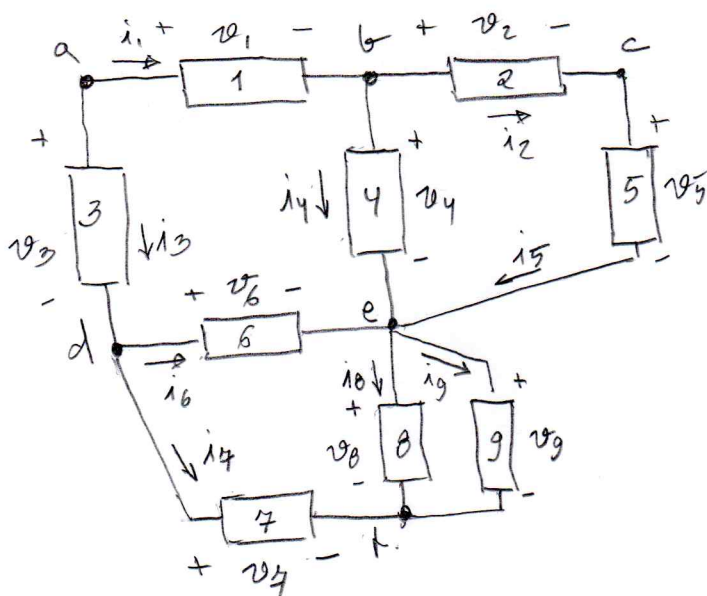
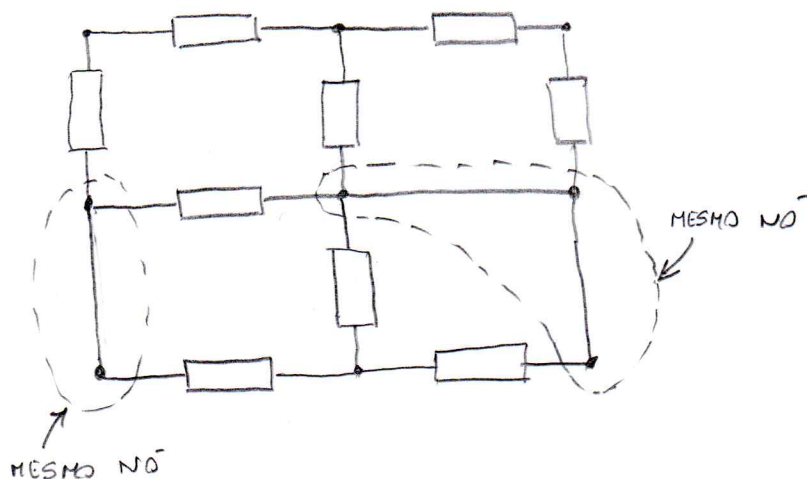


EXERCÍCIO 1



1. N° BÍPOLOS: $b = 9$
N° NÓS: $n = 6$ (a, b, ..., e, f)

2. VER UMA ALTERNATIVA DE SOLUÇÃO NA FIGURA

3. PARA AVALIAR O CONSUMO E FORNECIMENTO DE ENERGIA É NECESSÁRIO CONHECER AS CARACTERÍSTICAS DOS BÍPOLOS E RESOLVER O CIRCUITO.

4. a) $i_1 + i_3 = 0$

b) $-i_1 + i_2 + i_4 = 0$

c) $-i_2 + i_5 = 0$

d) $-i_3 + i_6 + i_7 = 0$

e) $-i_4 - i_5 - i_6 + i_8 + i_9 = 0$

SÃO 4 CORRENTES INDEPENDENTES.
POR EXEMPLO: i_1, i_2, i_4, i_8

5. SÃO 4 EQUAÇÕES INDEPENDENTES DE TENSÕES:

i) $-v_3 + v_1 + v_4 - v_6 = 0$

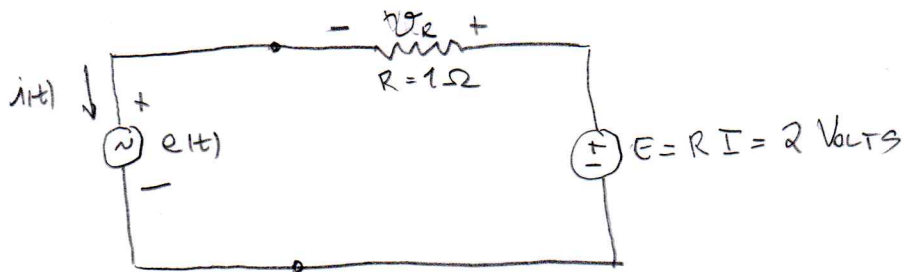
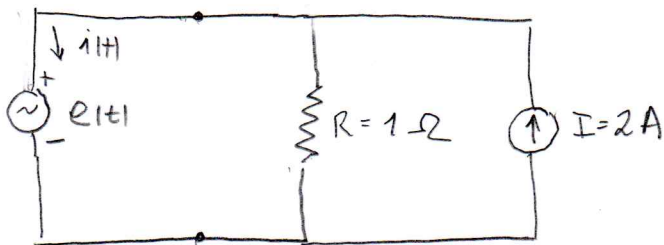
ii) $-v_4 + v_2 + v_5 = 0$

iii) $-v_4 + v_6 + v_8 = 0$

iv) $-v_8 + v_9 = 0$

SÃO 5 CORRENTES INDEPENDENTES.
POR EXEMPLO: v_3, v_4, v_5, v_6, v_9

EXERCÍCIO 2



$$-e(t) - v_R + E = 0$$

$$-e(t) - 1 \cdot i(t) + 2 = 0$$

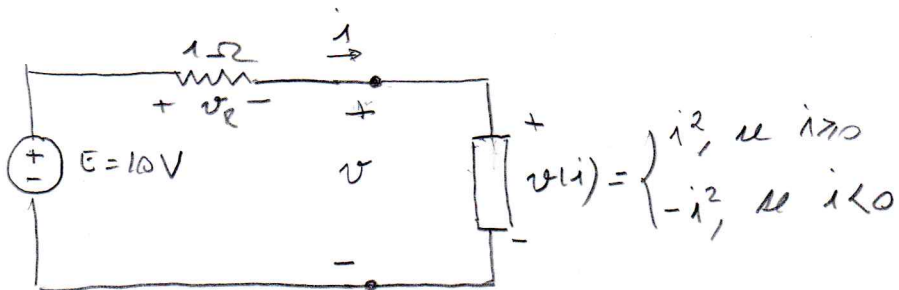
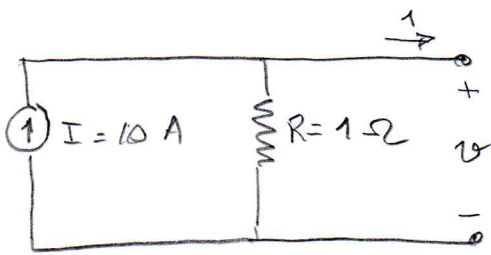
$$i(t) = \frac{2 - e(t)}{1}$$

$$i(t) = 2 - 2 \cdot \cos t \text{ A}$$

$$p(t) = e(t) \cdot i(t) = (2 \cos t)(2 - 2 \cos t) \text{ W}$$

$$p(t) = 4 \cos t - 4 \cos^2 t \text{ W}$$

EXERCÍCIO 3



$$-10 + v_R + v(i) = 0$$

$$-10 + 1 \cdot i + (i)^2 = 0$$

$$i^2 + i - 10 = 0 \therefore i = \frac{-1 \pm \sqrt{1+40}}{2} = \frac{-1 \pm 6,4}{2}$$

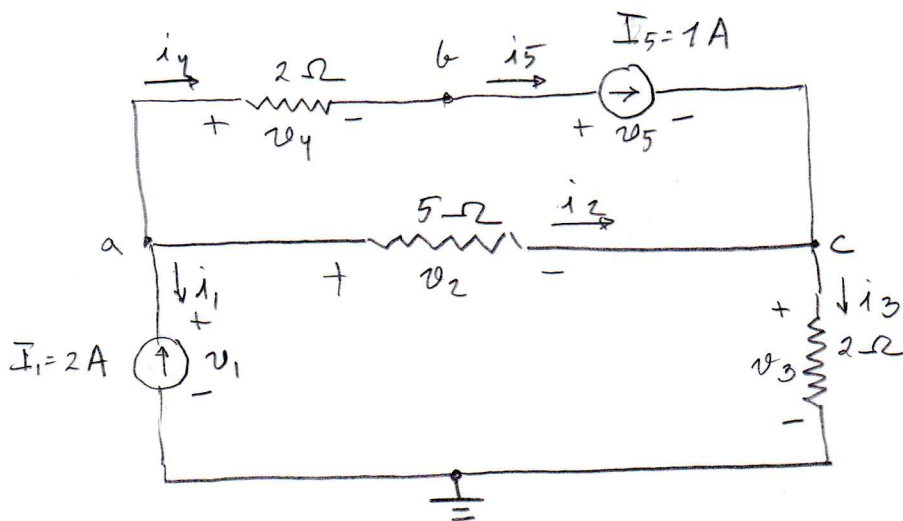
$$i = \cancel{3,4}$$

$$i = 2,7 \text{ A}$$

$$p = (v(i)) \cdot i = i^2 \cdot i = i^3 = 19,7$$

$$p = 19,7 \text{ W}$$

EXERCÍCIO 4



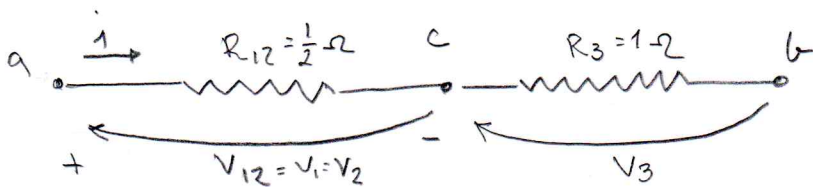
1. a) $i_1 + i_2 + i_4 = 0$
 b) $-i_4 + i_5 = 0$
 c) $-i_2 + i_3 - i_5 = 0$

2. i) $-v_2 + v_4 + v_5 = 0$
 ii) $-v_1 + v_2 + v_3 = 0$

3. $i_1 = -2A$
 $v_2 = 5 \cdot i_2$
 $v_3 = 2 \cdot i_3$
 $v_4 = 2 \cdot i_4$
 $i_5 = +1A$
- $-i_4 + i_5 = 0 \Rightarrow i_4 = 1A \Rightarrow v_4 = 2 \cdot i_4 = 2V$
- $i_1 = -2A$
 $i_1 + i_2 + i_4 = 0 \Rightarrow i_2 = -i_1 - i_4 = 2 - 1 = 1A \Rightarrow v_2 = 5 \cdot i_2 = 5V$
- i) $v_5 = v_2 - v_4 = 5 - 2 = 3V$
 c) $i_3 = i_2 + i_5 = 1 + 1 = 2A \Rightarrow v_3 = 2 \cdot i_3 = 4V$
 ii) $v_1 = v_2 + v_3 = 5 + 4 = 9V$

4. $v_1 = 9, i_1 = -2 \Rightarrow p_1 = -18W$ FORNECE ENERGIA ($p < 0$ c/ CONV. RECEPTOR)
 $v_2 = 5V, i_2 = 1A \Rightarrow p_2 = 5W$ CONSUME " ($p > 0$ c/ CONV. RECEPTOR)
 $v_3 = 4V, i_3 = 2A \Rightarrow p_3 = 8W$ CONSUME " "
 $v_4 = 2V, i_4 = 1A \Rightarrow p_4 = 2W$ CONSUME " "
 $v_5 = 3V, i_5 = 1A \Rightarrow p_5 = 3W$ CONSUME " "

EXERCÍCIO 5



$$V_M = V_{12} + V_3 = \left(\frac{1}{2} + 1\right) \cdot i = \frac{3}{2} i$$

$$\frac{V_3}{V_M} = \frac{1 \cdot i}{3/2 i} = \frac{2}{3} \Rightarrow V_3 = \frac{2}{3} V_M$$

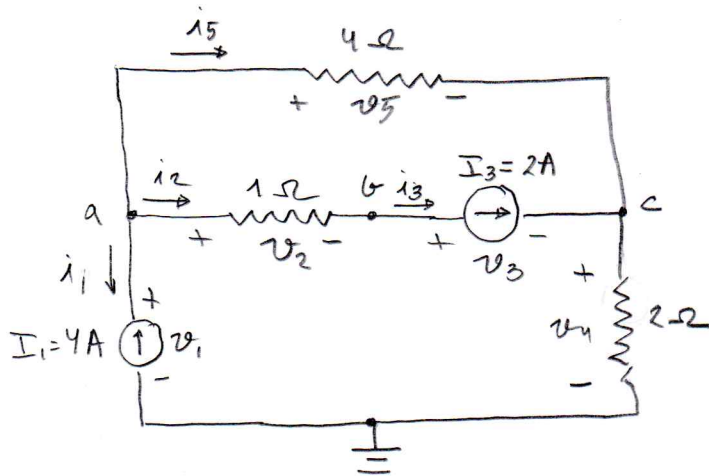
$$P_3 = V_3 \cdot i_3 = V_3 \cdot \left(\frac{V_3}{R_3} \right) = \frac{(V_3)^2}{R_3} = \frac{\left(\frac{2}{3} V_M \right)^2}{1} = \frac{4 (V_M)^2}{9} \Rightarrow P_3^{\text{max}} = 100 = \frac{4 (V_M)^2}{9} \quad (3)$$

(3) $\Rightarrow V_M''' = \sqrt{225} = 15 \text{ VOLTS}$

$$\Rightarrow V_H = \text{Min} \{ V_H^I, V_H^{II}, V_H^{III} \} = 9.5 \text{ Volts}$$

$$p_3 = \frac{4(9,5)^2}{9} \approx 40,1 \text{ W}$$

EXERCÍCIO 6



1. a) $i_1 + i_2 + i_5 = 0$
- b) $-i_2 + i_3 = 0$
- c) $-i_3 + i_4 - i_5 = 0$

$$\begin{aligned} 2. a) \frac{e_a - e_b}{1} + \frac{(e_a - e_c)}{4} &= 4 \\ b) -\frac{(e_a - e_b)}{1} &= -2 \\ c) -\frac{(e_a - e_c)}{4} + \frac{e_c}{2} &= 2 \end{aligned} \Rightarrow \begin{bmatrix} \frac{5}{4} & -\frac{1}{4} & -\frac{1}{4} \\ -\frac{1}{1} & \frac{1}{1} & 0 \\ -\frac{1}{4} & 0 & \frac{1}{2} + \frac{1}{4} \end{bmatrix} \begin{bmatrix} e_a \\ e_b \\ e_c \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \\ 2 \end{bmatrix}$$

$$\begin{aligned} a) \frac{5}{4} e_a - e_b - \frac{1}{4} e_c &= 4 \\ b) -e_a + e_b &= -2 \Rightarrow e_b = e_a - 2 \\ c) -\frac{1}{4} e_a + \frac{3}{4} e_c &= 2 \Rightarrow e_c = \frac{e_a}{3} + \frac{8}{3} \end{aligned} \Rightarrow \begin{aligned} \frac{5}{4} e_a - (e_a - 2) - \frac{1}{4} \left(\frac{e_a}{3} + \frac{8}{3} \right) &= 4 \\ 5e_a - 4e_a + 8 - \frac{e_a}{3} - \frac{8}{3} &= 16 \\ e_a - \frac{e_a}{3} &= 8 + \frac{8}{3} \\ 3e_a - e_a &= 24 + 8 = 32 \\ 2e_a &= 32 \Rightarrow e_a = 16 \text{ V} \\ e_b = e_a - 2 &\Rightarrow e_b = 14 \text{ V} \\ e_c = \frac{e_a}{3} + \frac{8}{3} &= \frac{16}{3} + \frac{8}{3} = \frac{24}{3} = 8 \\ e_c &= 8 \text{ V} \end{aligned}$$

4. e 5.

$v_1 = e_a = 16 \text{ V}, i_1 = -4 \text{ A} \Rightarrow p_1 = (16)(-4) = -64 \text{ W}$	FORNECE ($P < 0$)	4 CONV. RECEPTOR
$v_2 = e_a - e_b = 2 \text{ V}, i_2 = 2 \text{ A} \Rightarrow p_2 = (2)(2) = 4 \text{ W}$	CONSUME ($P > 0$)	1 CONV. RECEPTOR
$v_3 = e_b - e_c = 14 - 8 = 6 \text{ V}, i_3 = 2 \text{ A} \Rightarrow p_3 = (6)(2) = 12 \text{ W}$	CONSUME ()
$v_4 = e_c = 8 \text{ V}, i_4 = 4 \text{ A} \Rightarrow p_4 = (8)(4) = 32 \text{ W}$	CONSUME ()
$v_5 = e_a - e_c = 16 - 8 = 8 \text{ V}, i_5 = 2 \text{ A} \Rightarrow p_5 = (8)(2) = 16 \text{ W}$	CONSUME ()