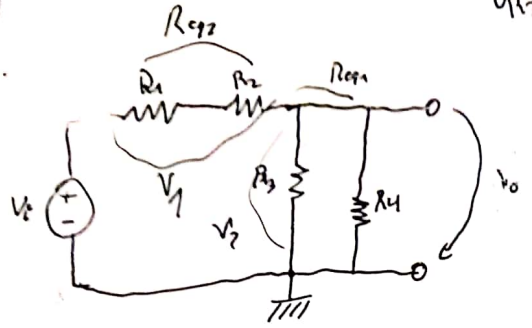
SE

$V_{R3} = V_{R4}$

Guião 1.

① 

$V_i = 12V$

$R_1 = 470\Omega$ $R_2 = 560\Omega$

$R_3 = 2.2 K\Omega$ $R_4 = 1,8 K\Omega$

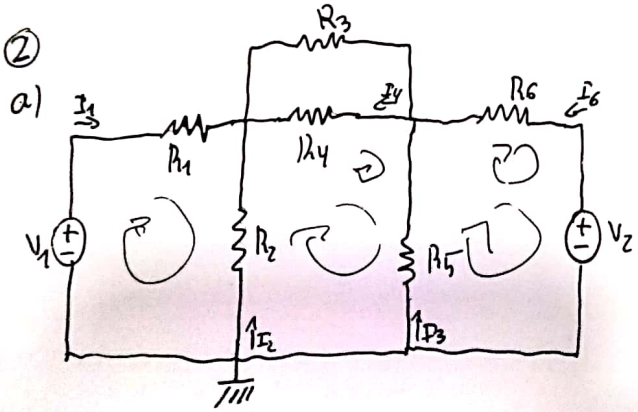
$\frac{1}{RE_{q1}} = \frac{1}{R_3} + \frac{1}{R_4} \Leftrightarrow \frac{1}{Req_1} = \frac{1}{990} \Leftrightarrow Req_1 = 990\Omega$

$Req_2 = R_1 + R_2 = 1030\Omega$

$12 = I(1030 + 990) \Leftrightarrow I = \frac{12}{2020} = 0,00594A$

$V_1 = 1030 \times 0,00594 = 6,1182$

$V_2 = 12 - 6,1182 = 5,8818$

② 

a)

$V_1 = 10V$ $V_2 = 5V$

$R_1 = 1K\Omega$ $R_2 = 560\Omega$

$R_3 = 220\Omega$ $R_4 = 470\Omega$

$R_5 = 100\Omega$ $R_6 = 1K\Omega$

$\frac{1}{Req} = \frac{1}{R_4} + \frac{1}{R_3} \Leftrightarrow Req \simeq 149,85\Omega$

$$\begin{cases} -10 + 1000 I_1 - 560 I_2 = 0 \\ 5 + 100 I_3 - 1000 I_6 = 0 \\ 560 I_2 - 149,85 I_4 - 100 I_3 = 0 \\ I_1 + I_2 + I_4 = 0 \Leftrightarrow I_4 = -(I_1 + I_2) \\ I_6 - I_4 + I_3 = 0 \end{cases}$$

$I_1 \simeq 0,00897A$

$I_2 = 0,00306A$

$I_3 = -0,0093A$

$I_6 = 0,00407A$

$I_4 = 0,00523A$ //

c) $V_{R1} = V_1 - V_{R2} = 10,09 - 1,12 = 8,97V$

$V_{R6} = V_2 - V_{R5} = 5,04 - 1,11 = 3,93V$

$I_1 = \frac{8,97}{1000} = 0,00897A$

$I_8 = \frac{3,93}{1000} = 0,00393A$

Exc 2.

8,95 R_1 $\quad V = RI \iff I = \frac{V}{R}$

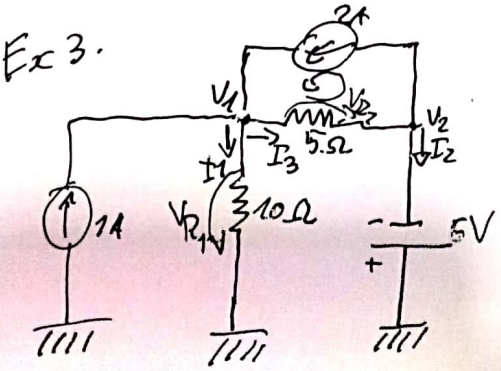
3,92 RG $\quad i_1 = \frac{8,95}{1000} = 0,00895$

$i_6 = \frac{3,92}{1000} = 0,00392$

c) $VR_2 = 1,12 \quad VR_5 = 1,11 \quad (\Omega)$

$V_1 = 10,09 \quad V_2 = 5,04 \quad (V)$

Ex 3.



V_1 : $1+2-I_1-I_3=0$

V_2 : $I_3-I_2-2=0$ $\iff$ $\begin{cases} I_1+I_3=3 \\ I_3-I_2=2 \end{cases}$

$2+5I_3=0 \iff 5I_3=-2 \iff I_3=-\frac{2}{5}A$

$I_2=-\frac{2}{5}-2=-\frac{12}{5}A$

$I_1=3-I_3 \iff I_1=3-(-\frac{2}{5})=\frac{17}{5}A$

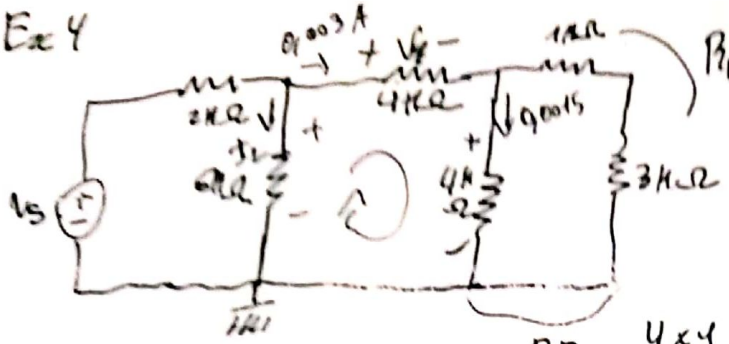
$V_{R_1}=10\times\frac{17}{5}=34V$

$V_{R_2}=5\times(-\frac{2}{5})=-2V$

$V_2=-5V$

$V_1=-5+VR_2=-7V$

Ex 4



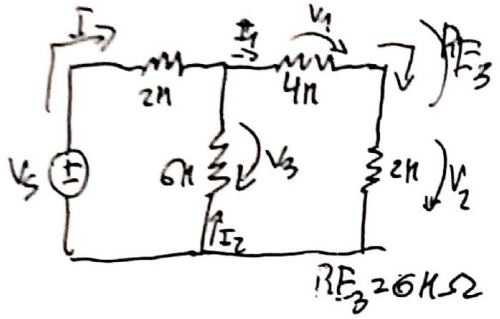
$R_{E_1} = 1+3 = 4k\Omega$

$12+6 = I_2 6.10^3 \Leftrightarrow 0,003$

$I = 0,003 + 0,003$

$V_s = 2.10^3 \times 0,006 = 12$

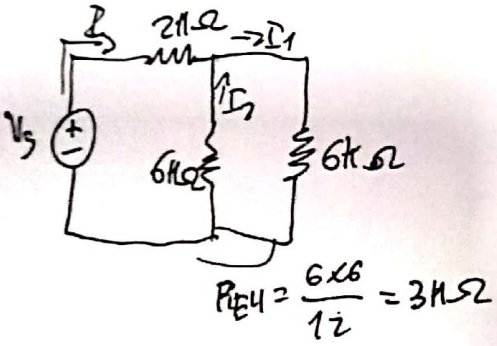
$R_{E_2} = \frac{4\times4}{8} = 2k\Omega$



$I_1 = \frac{12}{4000}\,A$

$I + I_2 - I_1 = 0 \Leftrightarrow I = I_1 - I_2$

Logo, $I_1 = I_2 = \frac{I}{2}$ $\quad I = \frac{24}{4000}A = \frac{6}{1000}A$



$V_s = 2000I + 3000I$

$= 30V$

Ex 5

a) $I_2 = gm\,V_{gs} \times \frac{Rd}{Rd+RL}$ (divisor de corrente)

$V_2 = RL \times I_2 = RL \times gm\,V_{gs} \times \frac{Rd}{Rd+RL}$

$V_{gs} = V_1 \times \frac{Rg}{R_1+Rg}$ (divisor de tensão)

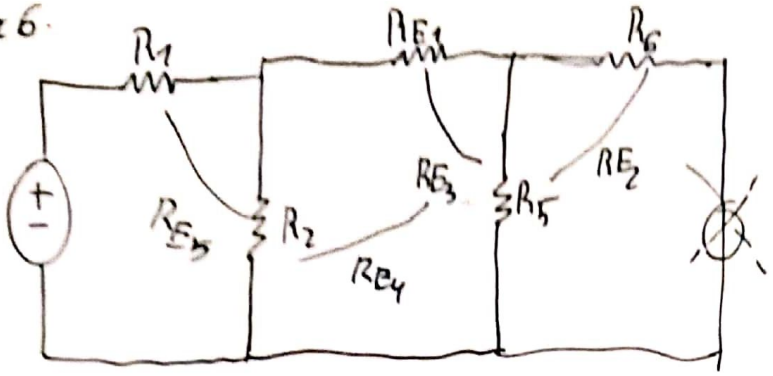
Logo,

$V_2 = RL \times gm \times V_1 \times \frac{Rg}{R_1+Rg} \times \frac{Rd}{Rd+RL} \Leftrightarrow \frac{V_2}{V_1} = RL \times gm \times \frac{Rg}{R_1+Rg} \times \frac{Rd}{Rd+RL}$

b) $\frac{V_2}{V_1} = 10.10^3 \times 10.10^{-3} \times \frac{9.10^6}{9.10^6+1.10^6} \times \frac{50.10^3}{50.10^3+10.10^3} = 75$

Ex 6.

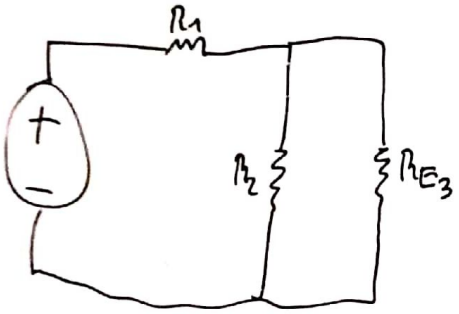
a)



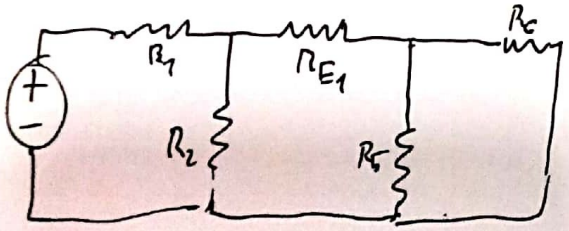
$R_{E1} = \frac{220 \times 470}{220+470} = 149,85\ \Omega$ $\quad R_{E3} = 90,90\ \Omega + 149,85\ \Omega = 240,76\ \Omega$

$R_{E2} = \frac{1000 \times 100}{1100} = 90,90\ \Omega$ $\quad R_{E4} = \frac{240,76\ \Omega \times 560\ \Omega}{560+240,76} = 168,37\ \Omega$

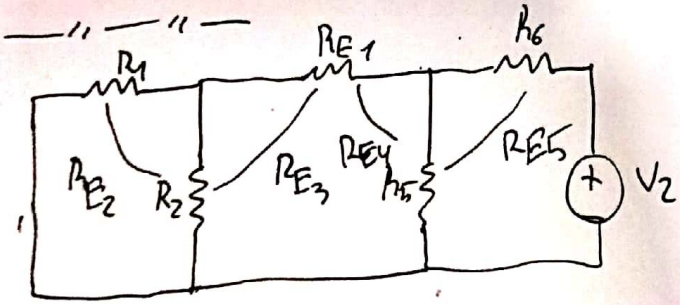
$R_{E5} = 1000 + 168,37\ \Omega = 1168,37\ \Omega$ $\quad I_1 = \frac{10}{1168,37} = 0,00856\ A$



$I_{R_{E_3}} = I_1 \frac{R_2}{R_2+R_{E_3}} = 0,00856 \times \frac{560}{560+240,76\ \Omega} = 0,00599\ A$



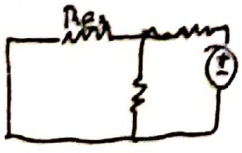
$I_6 = 0,00599\ A \times \frac{100}{1100} = 5,44 \cdot 10^{-4}\ A$



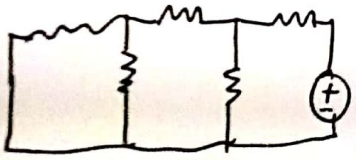
$R_{E2} = \frac{1000 \times 560}{1560} = 358.97\ \Omega$ $\quad R_{E4} = \frac{508,82 \times 100}{608,82} = 83,57\ \Omega$

$R_{E3} = 358.97 + 149,85 = 508,82\ \Omega$ $\quad R_{E5} = 83,57 + 1000 = 1083,57\ \Omega$

$I_6 = \frac{5}{1083,57} = 0,00461\ \Omega$



$I_{R_{E_3}} = 0,00461 \times \frac{100}{100+508,82} = 7,57 \cdot 10^{-4}\ A$



$I_1 = 7.57 \cdot 10^{-4} \times \frac{560}{1560} = 2,72 \cdot 10^{-4} A$

$I_1 = 0,00856 - 2,72 \cdot 10^{-4} = 0,008288\ A$ //

$I_6 = 0,00461 - 5,44\ 10^{-4} = 0,004066\ A$ //

Algc

Pesquisa binária (cont.)

```
...
middle = (left + right)/2;
while (left <= right) {
    if( ... )
    :
}
return ...;
```

Exemplo simples

Pior Caso	Sucesso	Falha
Nº de interações	n casos	$X < V[0]$
$W_I(n) = 1 + \log_2 n$	$X = V[i]$	$V[0] < X < V[1]$ } n+1 casos
		:
		$X > V[n-1]$

```
        indMax = j;
    }
    if (indMax != i)
        troca(&V[i], &V[indMax]);
}
```

$$\sum_{i=1}^{n-1} i = \frac{n-1}{2} \times n$$

TROCAS → dependem da configuração inicial.

$B_T(n) = 0$, se já ordenado

$W_T(n) = (n-1)$, Mas não é o array de ordem inversa.

$$A_T(n) = \sum_{n=2}^{n} (1 - \frac{1}{n}) \times 1 = n - \ln n$$

1 troca.

P(não estiver posição certa num array de n elementos) $= (1 - \frac{1}{n})$

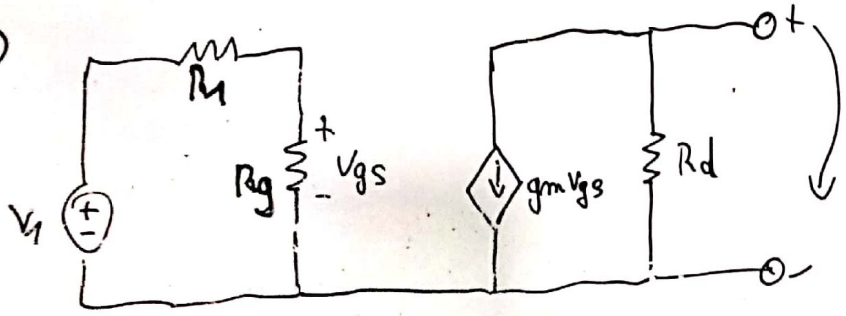
SE

Guião 1.

Ex 5

Thévenim

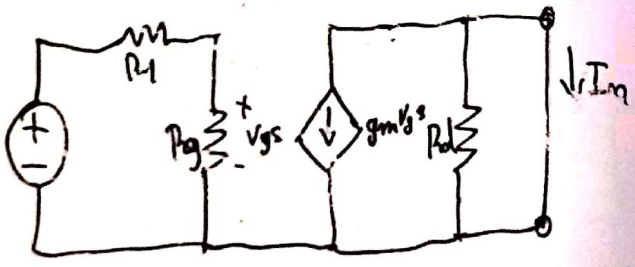
c)



$$V_t = g_m V_{gs} \times (-R_d) = -g_m \times \frac{V_1 R_g R_d}{R_1 + R_g} //$$

$$V_{gs} = V_1 \times \frac{R_g}{R_1 + R_g}$$

Nortom



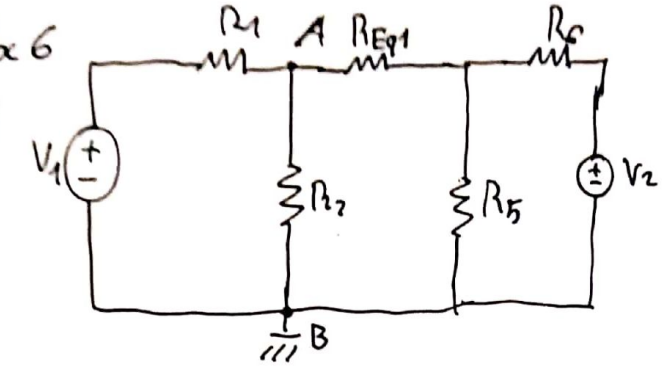
$$I_n = -g_m V_{gs}$$

$$V_{gs} = V_1 \times \frac{R_g}{R_1 + R_g}$$

$$I_n = -g_m \times \frac{V_1 R_g}{R_1 + R_g} //$$

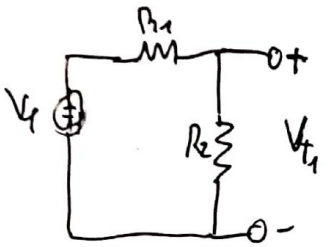
Ex 6

b)



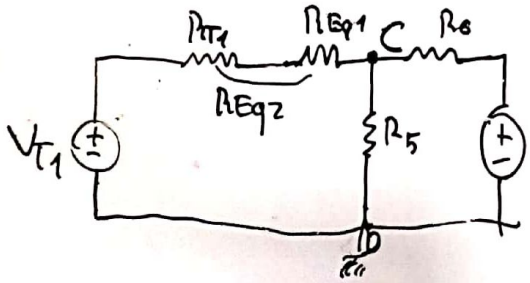
$R_{Eq1} = 144,85\Omega$

$R_{eq2} = 358,97 + 149,85 = 508,82$



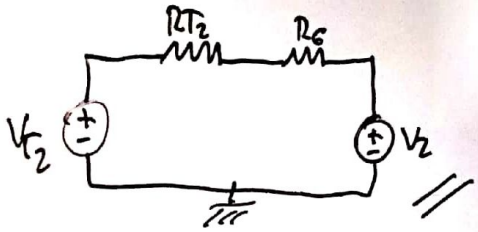
$V_{T1} = V_1 \times \frac{R_2}{R_1+R_2} = \frac{140}{39} = 3,59V$

$R_{T1} = \frac{1000 \times 560}{1560} = 358,97$



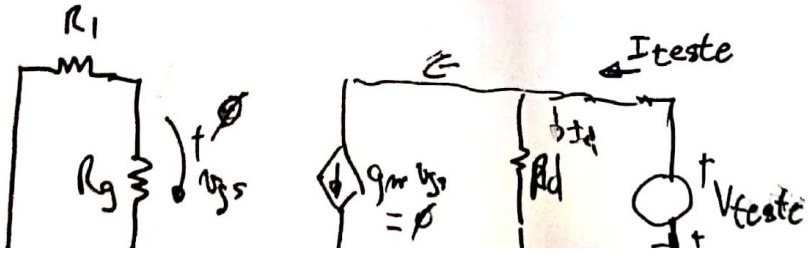
$V_{T2} = V_{T1} \times \frac{R_5}{R_5+R_{Eq2}} = 0,59V$

$R_{T2} = \frac{508,82 \times 100}{100 \times 508,82} = 83,57\Omega$



c) $V_{R_1} = 9,13\Omega$

Ex 5 c)



$R_N = R_d$

A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

		dp	g	f	e	d	c	b	a
		15	14	13	12	11	10	9	8
0 -> abcdEf	⟶	0	0	1	1	1	1	1	1 = 0x3F
1 -> bc	⟶	0	0	0	0	0	1	1	0 = 0x06
2 -> abged	⟶	0	1	0	1	1	0	1	1 = 0x5B
3 -> Abgcd	⟶	0	1	0	0	1	1	1	1 = 0x4F
4 -> fbgc	⟶	0	1	1	0	0	1	1	0 = 0x66
6 -> afedcg	⟶	0	1	1	1	1	1	0	1 = 0x7D
5 -> afgcd	⟶	0	1	1	0	1	1	0	1 = 0x6D
7 -> abc	⟶	0	0	0	0	0	1	1	1 = 0x07
8 -> abcdefg	⟶	0	1	1	1	1	1	1	1 = 0x7F
9 -> abcfg	⟶	0	1	1	0	0	1	1	1 = 0x67
A -> abcefg	⟶	0	1	1	1	0	1	1	1 = 0x77
b -> cdefg	⟶	0	1	1	1	1	1	0	0 = 0x7C
C -> adef	⟶	0	0	1	1	1	0	0	1 = 0x39
d -> bcdeg	⟶	0	1	0	1	1	1	1	0 = 0x5E
E -> adefg	⟶	0	1	1	1	1	0	0	1 = 0x79
F -> aefg	⟶	0	1	1	1	0	0	0	1 = 0x71

SE

Ficha 1.

1) $R_{E_1} = \frac{70 \times 30}{100} = 21\,\Omega$ (R_1 R_2) $\quad R_{E_2} = \frac{60 \times 40}{100} = 24\,\Omega$ (R_3 R_4) $\quad R_{EAB} = 21\,\Omega + 24\,\Omega = 45\,\Omega$

2) $R_{E_1} = \frac{18 \cdot 10^3 \times 63 \cdot 10^3}{18 \cdot 10^3 + 63 \cdot 10^3} = 14\,k\Omega$ $\quad R_{ab} = 4 \cdot 10^3 + 6 \cdot 10^3 + 12 \cdot 10^3 = 22\,k\Omega$

$R_{E_2} = \frac{30 \cdot 10^3 \times 15 \cdot 10^3}{30 \cdot 10^3 + 15 \cdot 10^3} = 10\,k\Omega$

$R_{E_3} = 14 \cdot 10^3 + 10 \cdot 10^3 + 6 \cdot 10^3 = 30\,k\Omega$

$R_{E_4} = \frac{30 \cdot 10^3 \times 20 \cdot 10^3}{30 \cdot 10^3 + 20 \cdot 10^3} = 12\,k\Omega$

Pior caso – Fase de Ordenação

$W_{c\ ordenação}(n) = \sum_{k=1}^{n-1} 2L \log_2 k \rfloor$ ← Não há formula fechada.

$W_{c\ ordenação}(n) \in O(n \log n)$

SE

Condensadores

$102 = 10 \cdot 10^2 = 1000\,pF = 1\,nF$

$473 = 47 \cdot 10^3 = 47\,000\,pF = 47\,nF$

$\tau = RC = 10k\Omega \times 1mF$

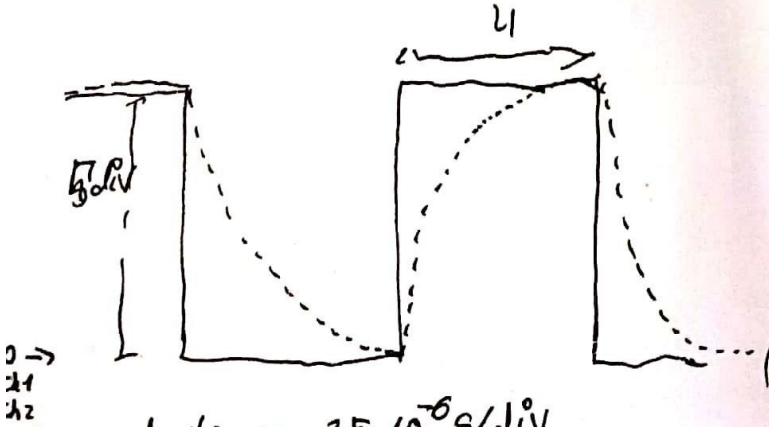
Guião 2. pt 1

1.1. a)

---- canal 2

—— canal 1

5 Hz



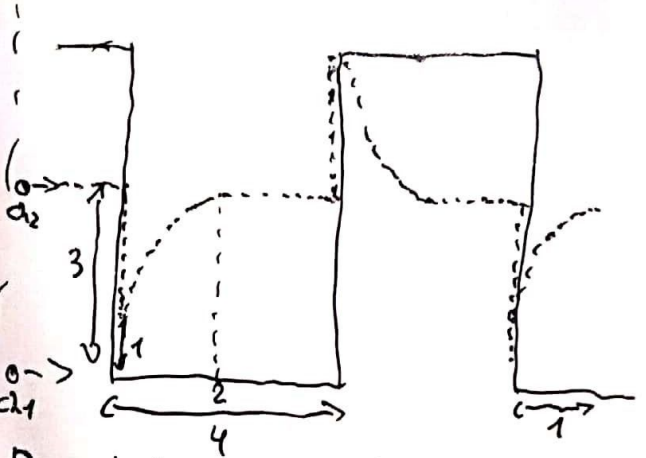
Base de tempo $25 \cdot 10^{-6}$ s/div

V_i = ch.1 1V/div

Ponta X: 1 Acopl: CC

V_o = ch2. 1V/div

Ponta x: 1x Acopl: CC



Base de tempo $25 \cdot 10^{-6}$ s/div

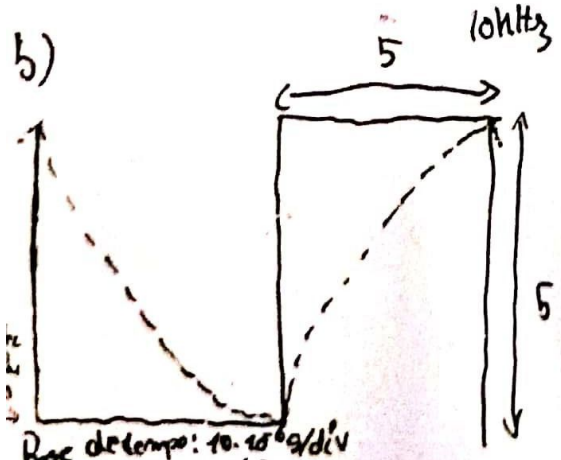
V_i = ch1 1V/div

Ponta x: 1x Acopl: CC

V_o = ch2 2V/div

Ponta x: 1x Acopl: CC

b) 10kHz



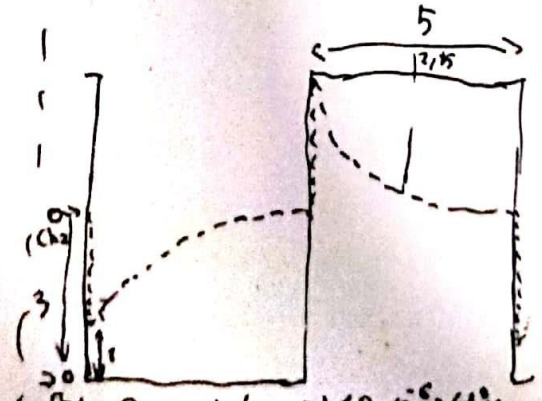
Base de tempo: $10 \cdot 10^{-6}$ s/div

V_i = ch.1 1V/div

Ponta x: 1x Acopl: CC

V_o = ch.2 1V/div

Ponta x: 1x Acopl: CC



Base de tempo: $10 \cdot 10^{-6}$ s/div

V_i: ch1 1V/div

Ponta x: 1x Acopl: CC

V_o: Ch2 2V/div

CC CC

$W_{condensador}$ (n) é o (energia)

SE

Condensadores

$102 = 10 \cdot 10^2 = 1000\,pF = 1\,nF$

$473 = 47 \cdot 10^3 = 47\,000\,pF = 47\,nF$

$\tau = RC = 10k\Omega \times 1\,mF$

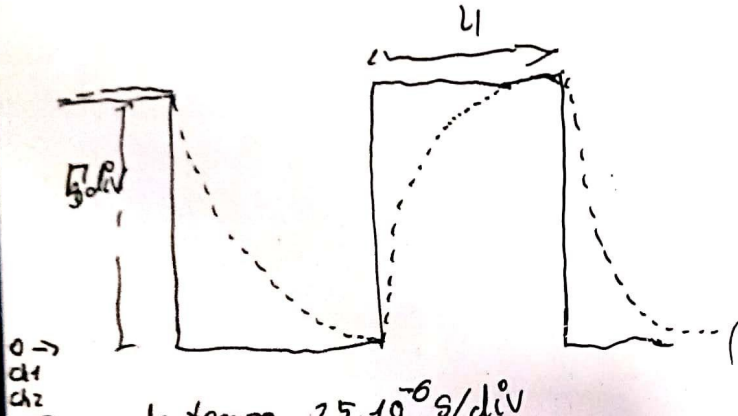
Guião 2. pt 1

1.1. a)

..... canal 2

—— canal 1

5 1 kHz



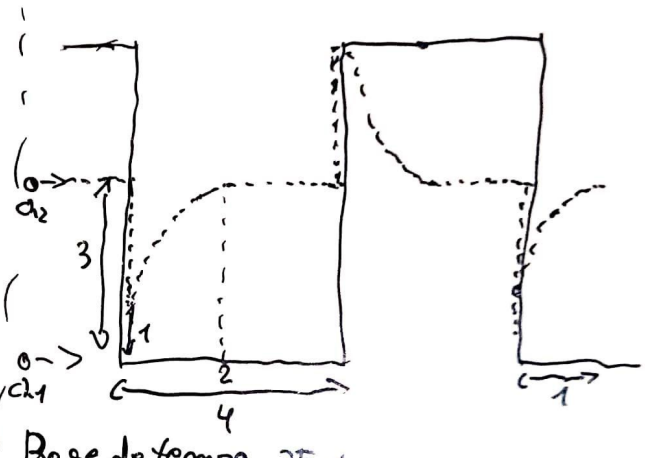
Base de tempo $25 \cdot 10^{-6}$ s/div

V_i = ch.1 1V/div

Ponta X: 1 Acopl: CC

V_o = ch2. 1V/div

Ponta x: 1x Acopl: CC



Base de tempo 25...

V_i = ch1. 1V/div

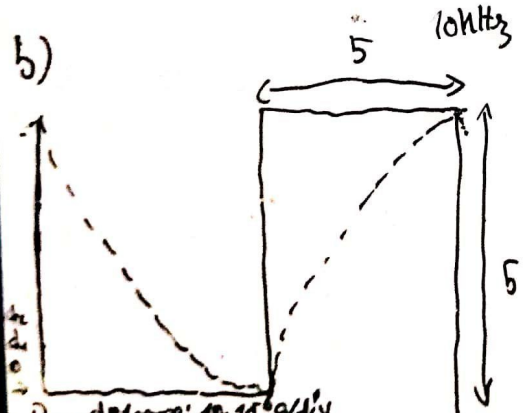
Ponta x: 1x Acopl: CC

V_o = ch2. 2V/div

Ponta x: 1x Acopl: CC

b)

10 kHz



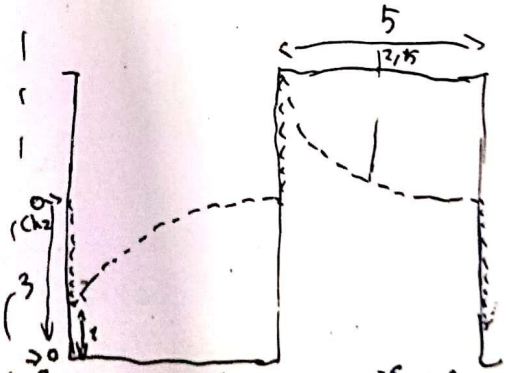
Base de tempo: $10 \cdot 10^{-6}$ s/div

V_i = ch.1 1V/div

Ponta x: 1x Acopl: CC

V_o = ch.2 1V/div

Ponta x: 1x Acopl: CC



Base de tempo: $10 \cdot 10^{-6}$ s/div

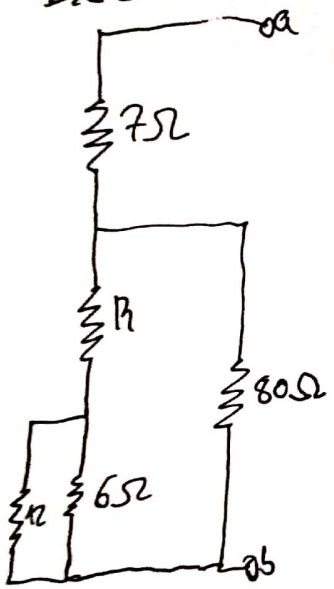
V_i: ch1 1V/div

Ponta x: 1x Acopl: CC

V_o: ch.2 2V/div

Ponta x: 1x Acopl: CC

Ficha 1
Ex 3.



$$Req_1 = \frac{12 \times 6}{12+6} = 4\,\Omega$$

$$Req_2 = 4 + R$$

$$Req_3 = \frac{(4+R)80}{80+4+R} = \frac{320+80R}{84+R}$$

$$Req_4 = \frac{320+80R}{84+R} + 7 =$$

$$= \frac{320+80R+7(84+R)}{84+R} =$$

$$= \frac{908+87R}{84+R} = 23\,\Omega$$

$$\Leftrightarrow 908+87R = 23(84+R) \Leftrightarrow R = 16\,\Omega$$

```
if max = 0
for(i=0; i<n; i++)
{
  if((n-i)<=max) break;
  int rep=1;
  for(j=i+1; j<n; j++)
  {
    count++;
    if(array[i]==array[j]){
      repeticoes++;
```

```
    if(rep>max) max=rep;
    count++;
  }
return max;
```

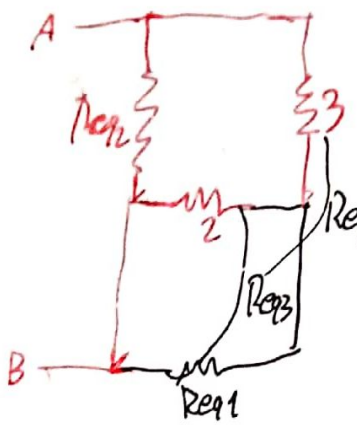
	Al.	Guloso	Res	Ops	
1º seq →	1	10	10		resultado = n
2 seg. →	1	9	10	Bc(n)	resultado = n-1
3 seq →	1	8	19	=	3n+n-1
4 seq →	1	7	27	=	n(3)+n-2

$$A_c^{(n)}_{exp} = \frac{395}{11} = 35,9 \approx 36 = 3n+6-\frac{n}{n}$$

SF

Ficha 1 (teórica)

Ex 4.



$Req_1 = \frac{6\times3}{6+3} = 2\,\Omega$

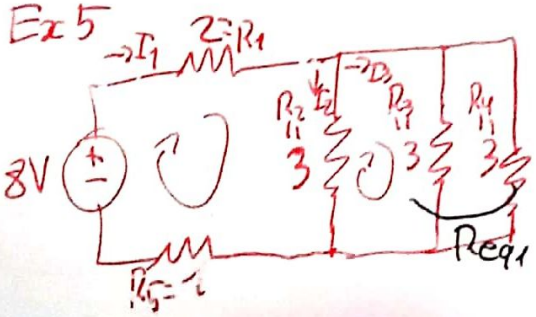
$Req_2 = \frac{12\times6}{18} = 4\Omega$

$Req_3 = 2//2 = 1\,\Omega$

$Req_4 = 1+3 = 4\Omega$

$R_{AB} = 4//4 = 2\,\Omega$ //

Ex 5



I_{R_2}?

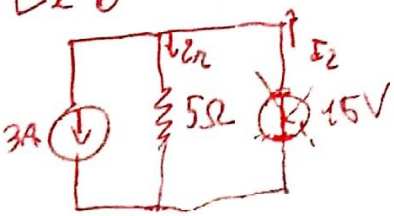
V_{R_2}?

$Req_1 = 3//3 = \frac{3}{2}$

$V_{R_2} = \frac{2}{3}\times3 = 2V$ //

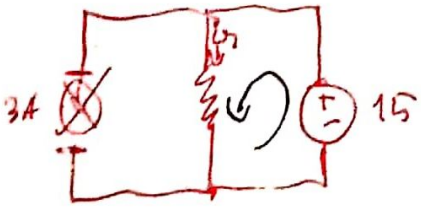
$$\begin{cases} -8+2I_1+3I_2+I_1=0 \\ \frac{3}{2}I_3-3I_2=0 \\ I_1=I_2+I_3 \end{cases} \Leftrightarrow \begin{cases} 3I_1+3I_2=8 \\ -3I_2+\frac{3}{2}I_3=0 \\ I_1-I_2-I_3=0 \end{cases} \begin{cases} I_1=2 \\ I_2=2/3 \\ I_3=4/3 \end{cases}$$

Ex 6



$I_2 = 3A$

$I_{2a} = 0A$, pq não passa nenhuma corrente pela resistência



$I_{2B} = -15+5I_{2b} = 0 \Leftrightarrow I_{2b} = 3A$

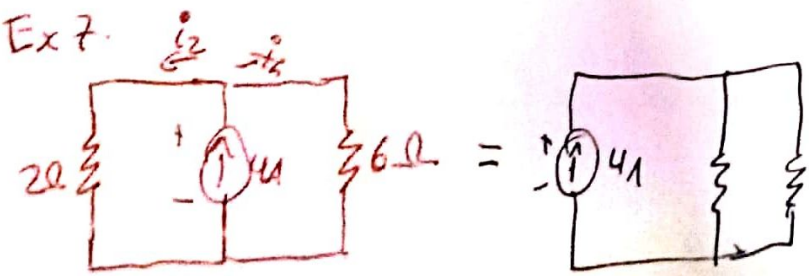
$I_2 = I_{2a}+I_{2b} = 3A$

$I_2 = I_2+3A = 6A$

$P = V\times I$

$= 15\times6 = 90\,W$ //

Ex 7.



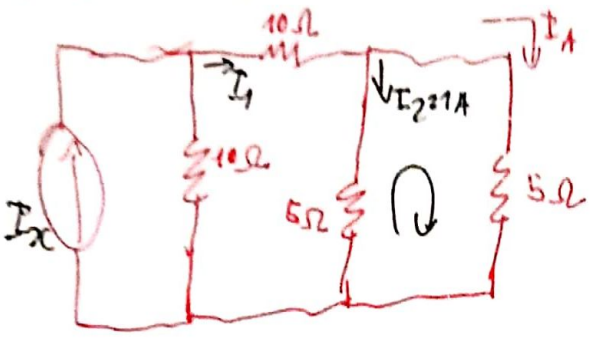
$i_6 = 4\times\frac{6}{6+2}$ (divisor de corrente)

$= 3A$

$i_6 = 1A$ //

SE

Ex 8 I_x?



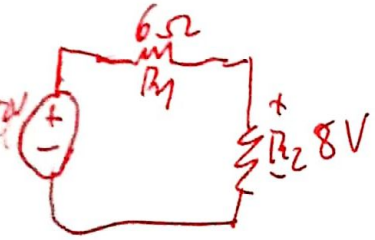
$5 - 5I_2 = 0 \Leftrightarrow I_2 = 1$

$I_1 = I_2 + 1A \Leftrightarrow I_1 = 2A$

$R_E = (5 // 5) + 10 = 12{,}5\ \Omega$

$2 = I_x \frac{20}{10+12{,}5} \Leftrightarrow I_x = 4{,}5A$ //

Ex 9.

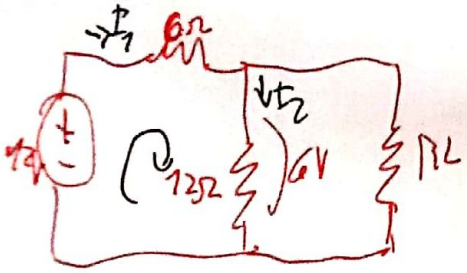


$8 = 12 \frac{R_2}{R_2+R_1} \Leftrightarrow R_2 = 12\ \Omega$

$V = RI$

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

$I_2 = \frac{6}{12} = \frac{1}{2}A$

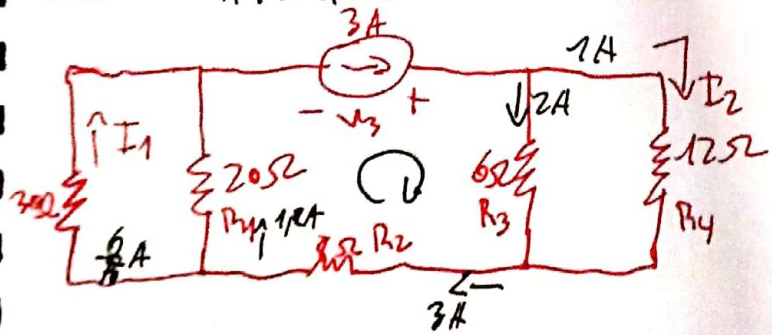


$-12 + 6I_1 + 6 = 0 \Leftrightarrow I_1 = 1A$

$\frac{1}{2} = 1 \cdot \frac{RL}{12+RL} \Leftrightarrow RL = 12$

Como a I divide-se em metade para I_2 logo as resistências são iguais

Ex 10 I_1, I_2, V_3?

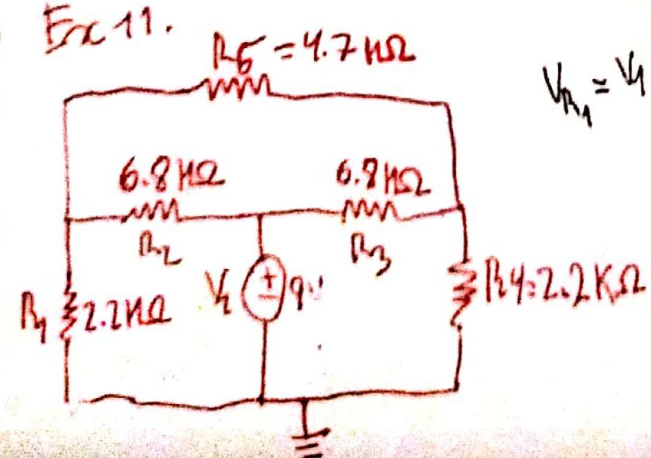


$I_2 = 3 \frac{6}{18} \Leftrightarrow I_2 = 1A$ //

$I_1 = 3 \frac{20}{50} \Leftrightarrow I_1 = \frac{6}{5}A$ //

$-V_3 + 2 \times 6 + 9 \times 3 + 1 \times 20 = 0 \Leftrightarrow V_3 = 72V$ //

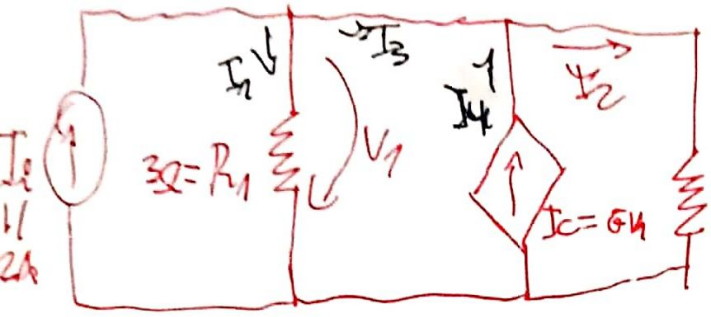
Ex 11.



$V_{R_1} = V_1 \cdot \frac{R_1}{R_2+R_1} = 2.2V$

I_5=?

12. $V=RI$ $V_1=?$ $G=400mS$ $I_2=?$ $V_1=V_c=V_2$



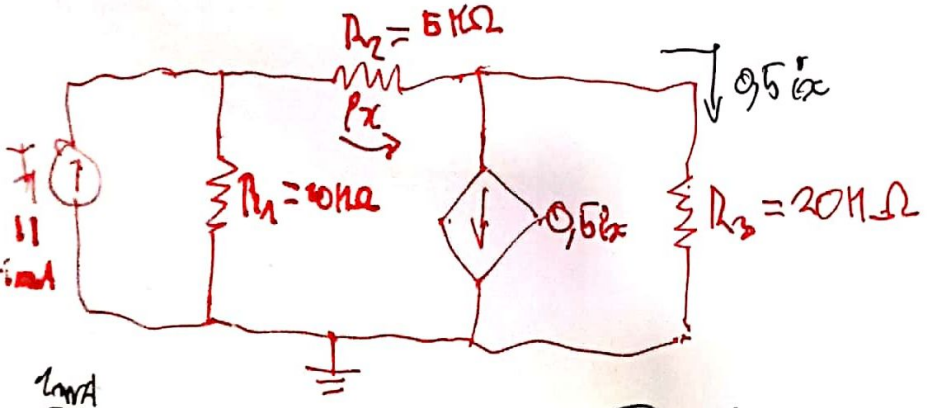
$I_2 = I_3 + I_C$
$= I_3 + 0,4 \times 3(I_1 - I_3)$
$= I_3 + 1,2(2 - I_3)$
$= 2,4 - 0,2I_3$

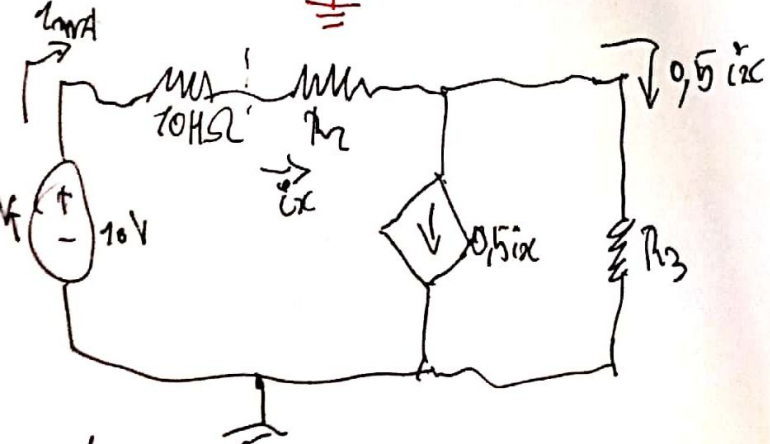
$V_1 = V_2$

$(2-I_3)\times 3 = (2,4-0,2I_3)\times 5 \Leftrightarrow 6-3I_3 = 12 - I_3 \Leftrightarrow -2I_3 = 6 \Leftrightarrow I_3 = -3A$

$V_1 = (2-(-3))\times 3 = 15V = V_2$ $\quad I_2 = \frac{V_2}{R_2} = \frac{15}{5} = 3A$

13.





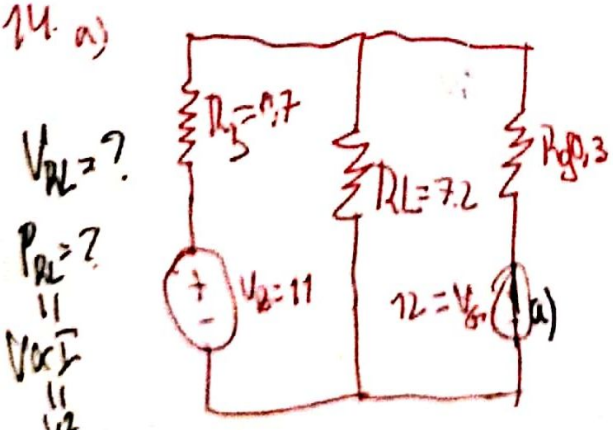
$10 = 10.10^3 \times ix + 5.10^3 ix + 0,5\, ix \times 20.10^3$

$10 = ix(10+5+10).10^3$

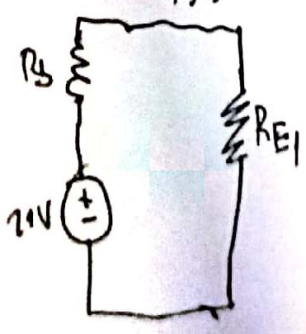
$ix = \frac{10}{25.10^3} \Leftrightarrow ix = 4.10^{-4} A$

$V_1 = 1mA \times 10k\Omega$
$= 10V$

14. a)



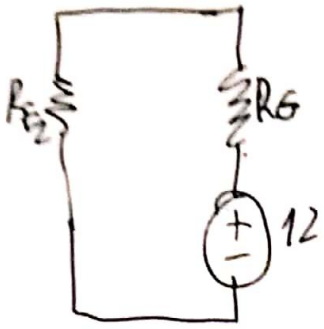
a) $R_{E1} = \frac{7,2 \times 0,3}{7,5} = 0,288\Omega$



$V_{RE1} = 11 \times \frac{R_{E1}}{R_3 + R_{E1}} = 3,2V$

$V_{RLa} = 3,2 \cdot \frac{R_L}{R_L + R_0} = 3,07$

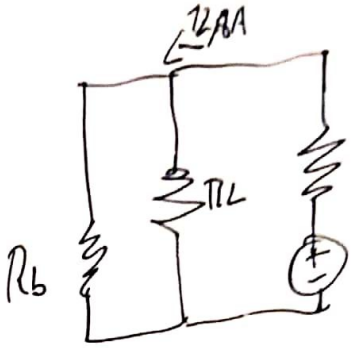
5) $R_{E2} = \frac{7,2 \times 0,7}{7,9} = 0,64\,\Omega$



$V_{RE_2} = 12 \times \frac{R_{E_2}}{R_{E_2}+R_G} = 8,2\,V$ $\quad I_{RE_2} = \frac{8,2}{0,64\,\Omega} = 12,8\,A$

$I_{RL_b} = 1,9 \times \frac{R_b}{R_L+R_b} = 1,14\,A$

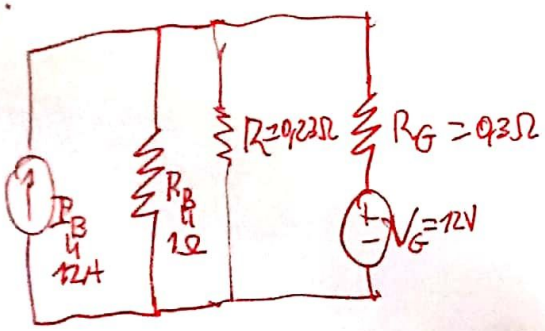
$V_{RL_b} = 1,14 \times 7,2 = 8,208\,V$



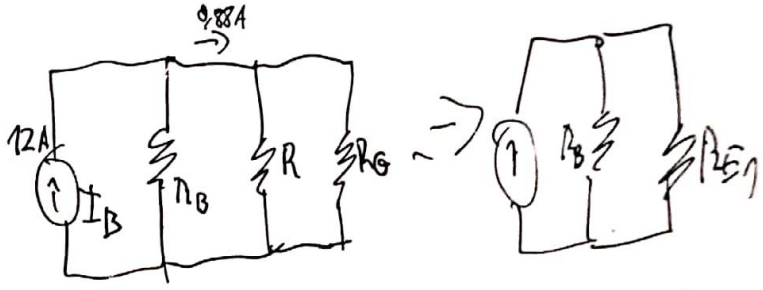
$V_{RL} = V_{RLa} + V_{RLb} = 3,072 + 8,208 = 11,29\,V$

$P = \frac{V_{RL}^2}{R_L} = 17,09\,W$

15.



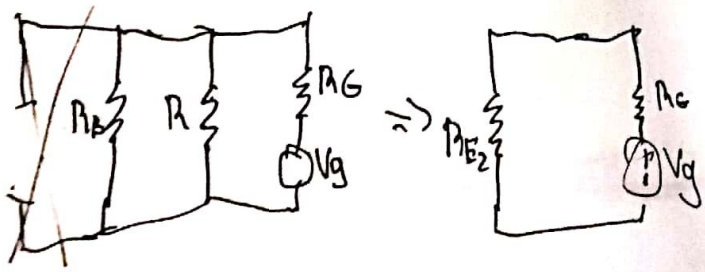
a)



$R_{E_1} = \frac{R \times R_G}{R+R_G} = 0,13\,\Omega$ $\quad I_{RE_1} = 12 \times \frac{R_B}{R_B+R_{E_1}} = 10,62\,A$ $\quad I_R = 10,62 \times \frac{R_G}{R+R_G} = 6\,A$

$V_{R1} = I_R \times R = 1,38\,V$

b)



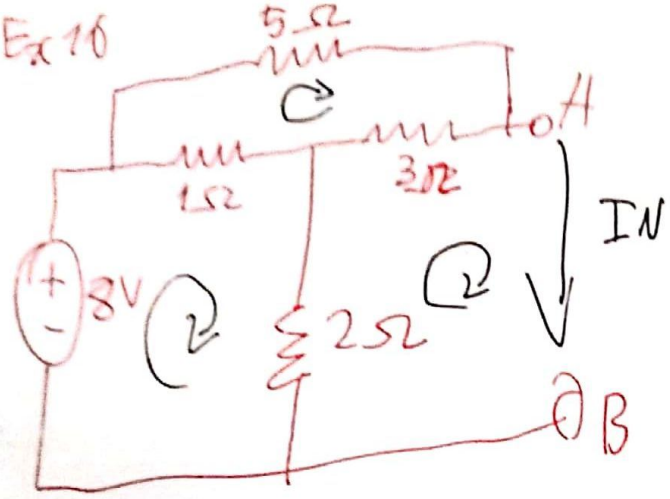
$V_{RE_2} = V_g \times \frac{R_{E_2}}{R_{E_2}+R_g} = 4,61\,V$

$R_{E_2} = \frac{12 \times R_B}{R+R_B} = 0,19$

$I_{RE_2} = \frac{4,61}{R_{E_2}} = 24,25\,A$ $\quad I_R = I_{RE_2} \times \frac{R_B}{R+R_B} = 19,72\,A$ $\quad V_{R_2} = 0,23 \times 19,72 = 4,53\,V$

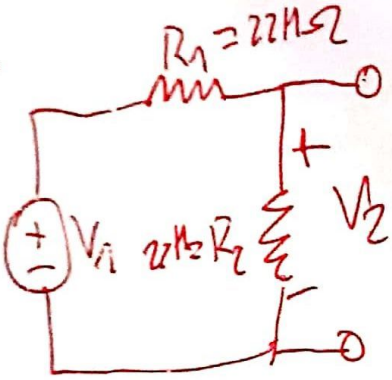
$V_R = 4,53 + 1,38 = 5,91\,V$

Ex 10

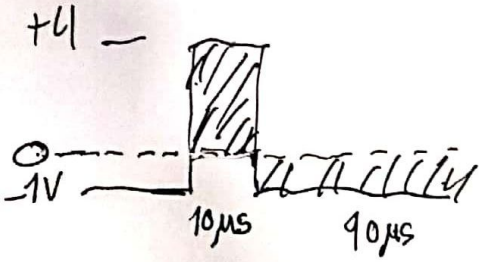


Ficha 2.

1.



$V_2 = V_1 \times \frac{22.10^3}{44.10^3} \Leftrightarrow V_2 = \frac{V_1}{2}$



$T = 100.10^{-6}\,s$

$V_{pp} = 5\,V$

$V_m = 4 \times 0,1 - 1 \times 0,9 = -0,5\,V$

$V_{ef}^2 = \frac{1}{T}\int_0^T v(t)^2 dt = \frac{1}{T}\left(\int_0^{10\mu s} 4^2 dt + \int_{10\mu s}^{100\mu s} (-1)^2 dt\right) = \frac{1}{100.10^{-6}}\left(1,6.10^{-4} + 0,9.10^{-4}\right)$

$\Leftrightarrow V_{ef} = \sqrt{25}$

$\Leftrightarrow V_{ef} = 1,58\,V_{rms}$

$\delta(\text{duty-cide}) = \frac{10.10^{-6}}{100.10^{-6}} \times 100 = 10\%$

2.

$V_{pp} = 3V$

$V_m = 1,5\,V$

3. $V_{pp} = 300\,V$

$V_{ef} = \frac{V_{max}}{\sqrt{2}} = \frac{150}{\sqrt{2}} = 106\,V_{rms}$

$f = 100\,Hz$

$T = \frac{1}{100} = 10\,ms$

$\omega = 200\pi \simeq 628\,rad/s$

$P = \frac{V^2}{R} = \frac{106^2}{50} = 225\,W$

$\cos(\omega) \rightarrow$ pico positivo $\rightarrow x = 0$

$200\pi t - 36^\circ = 0 \Leftrightarrow 200\pi t - 0,2\pi = 0$

$\Leftrightarrow t = \frac{0,2\pi}{200\pi} \Leftrightarrow t_{max} = 1.10^{-3}\,s$

C.A

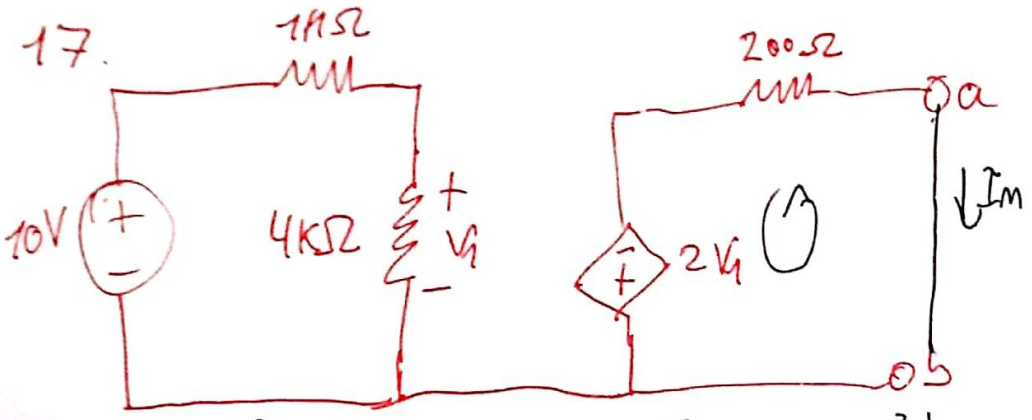
180 — π

36 — x

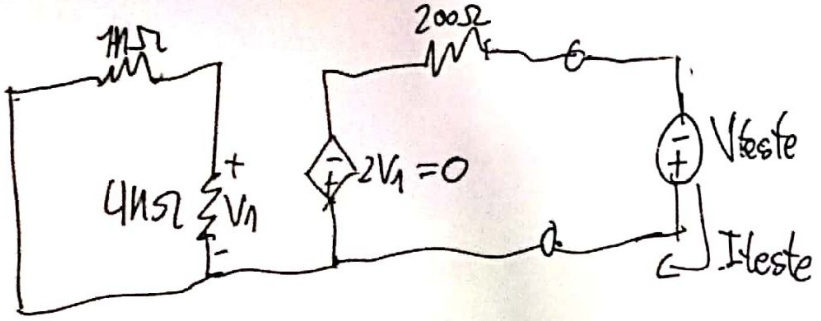
x = 0,2π

Ficha 1.

17.



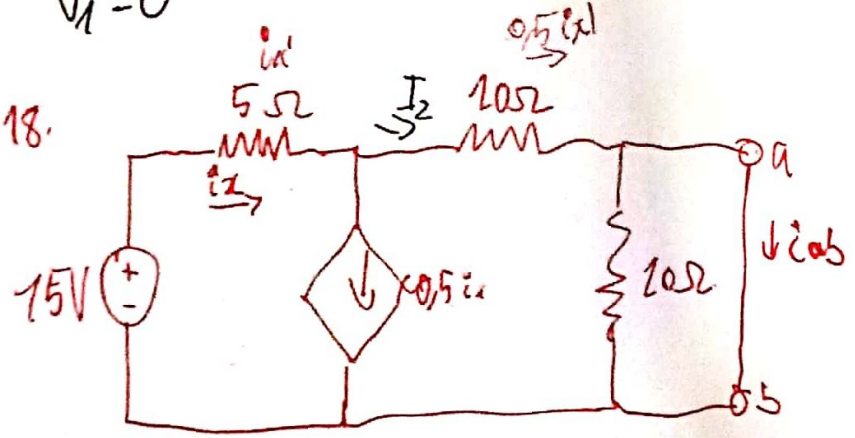
$V_1 = 10 \frac{4 \cdot 10^3}{5 \cdot 10^3} = 8V$ $\quad I_N = -\frac{2 \times 8}{200} = -80 \cdot 10^{-3} A$



$R_N = 200\Omega$

$V_1 = 0$

18.



R_{EQ} (10 // 5)

$* \; -5I_x - 5I_x = V_{teste}$

$V_{teste} = 10 I_{teste}$

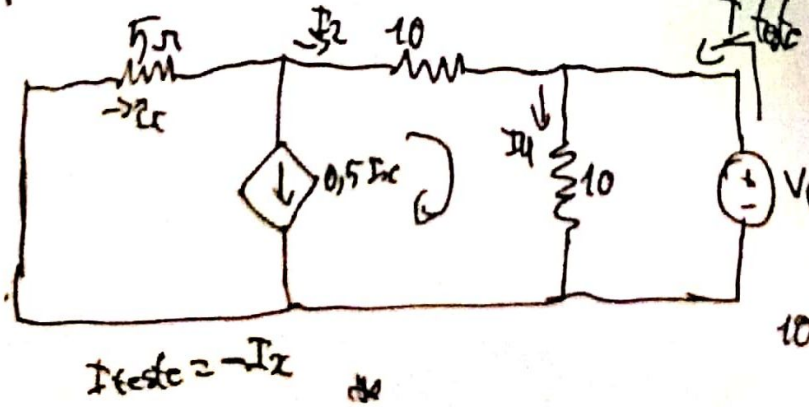
$R_T = \frac{10 I_{teste}}{I_{teste}} = 10\Omega$

$R_T = \frac{V_T}{i_{ab}}$ $\quad i_{ab} = 0,5 i_x$

$15V = 5 i_x + 10 \times 0,5 i_x$

$$\begin{cases} I_x = 0,5 I_x + I_2 \\ 15 = 5 I_x + 20 I_2 \end{cases} \Leftrightarrow \begin{cases} \frac{I_x}{2} = I_2 \\ I_2 = \frac{15 - 5 I_x}{20} \end{cases} \Leftrightarrow \begin{cases} \frac{I_x}{2} = \frac{15}{20} - \frac{I_x}{4} \\ I_2 = \frac{15}{20} - \frac{I_x}{4} \end{cases} \Leftrightarrow \begin{cases} \frac{3I_x}{4} = \frac{15}{4} \\ \text{---} \end{cases} \begin{cases} I_x = 1A \\ I_2 = 0,5A \end{cases}$$

$V_T = 10 \times 0,5 = 5V$



$I_x = 0,5 I_x + I_2 \Leftrightarrow I_2 = \frac{I_x}{2}$

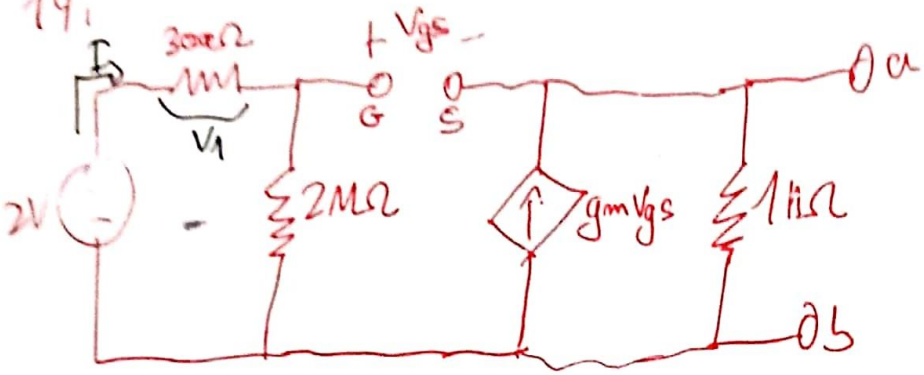
$I_2 + I_{teste} = I_4$

$\Leftrightarrow I_{teste} = I_4 - \frac{I_x}{2}$

$10 \frac{I_x}{2} + 10 I_4 = 0 \Leftrightarrow I_4 = -\frac{I_x}{2}$

$g_m = 19\,ms$

19.



$V_T = 1 \cdot 10^3 \times 19 \cdot 10^{-3} \cdot V_{gs}$

$V_{gs} = V_G - V_S$

$2 = 300I + 2 \cdot 10^6 I \Leftrightarrow I = \frac{2}{2000300}\ A$

$V_1 = \frac{2}{2000300} \times 300 \approx 3 \cdot 10^{-4}\ V$

$V_G = 2 - 3 \cdot 10^{-4} \approx 1{,}9997\ V \simeq 2V$

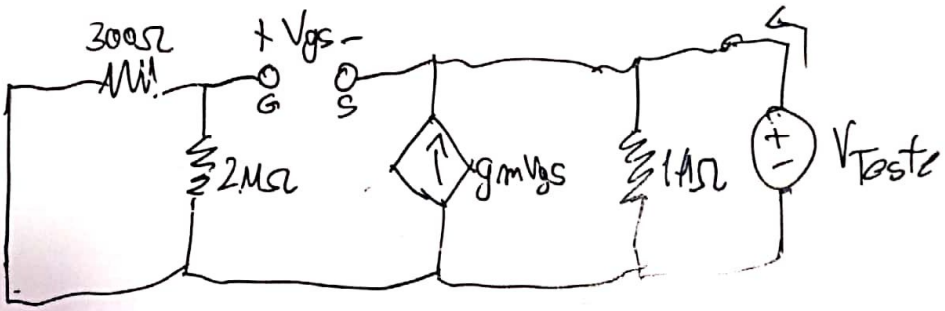
$1 \cdot 10^3 \times 19 \cdot 10^{-3}(V_G - V_S) = V_S \Leftrightarrow$

$\Leftrightarrow 1 \cdot 10^3 \times 19 \cdot 10^{-3} \times 1{,}9997 = 20\,V_S \Leftrightarrow$

$\Leftrightarrow V_S = 1{,}8997\ V$

$V_{gs} = 0{,}1\ V$

$V_T = 1{,}9\ V$



$V_G = 0$

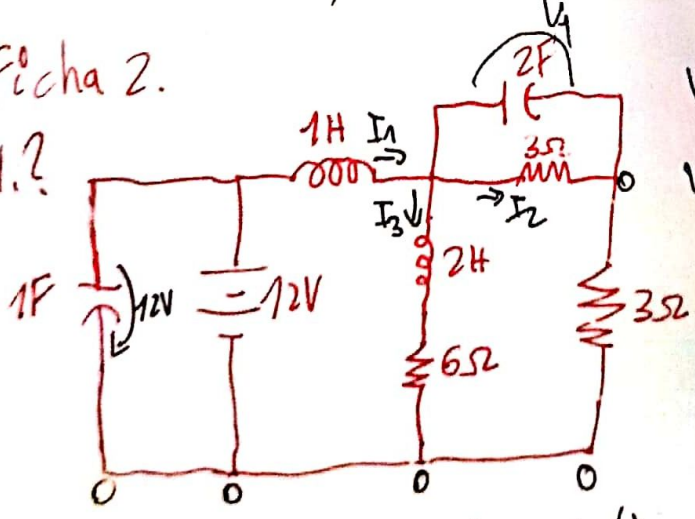
$V_S = 1 \cdot 10^3 \times \left(I_{teste} + 19 \cdot 10^{-3}(-V_S)\right) \Leftrightarrow V_S = 1 \cdot 10^3 I_{teste} - 19\,V_S \Leftrightarrow V_S = 50\,I_{teste}$

$V_{teste} = 1 \cdot 10^3 \times (0{,}019 \times (-50 I_{teste}) + I_{teste}) \Leftrightarrow V_{teste} = 50\,I_{teste}$

$R_T = \frac{V_{teste}}{I_{teste}} = \frac{50 I_{teste}}{I_{teste}} = 50\,\Omega$ //

Ficha 2.

4.?



Regime permanente → $I_C = 0$ (circuito aberto)

$t > 5\tau$ ↳ $V_B = 0$ (curto-circuito)

$W_C = \frac{1}{2} C V^2$

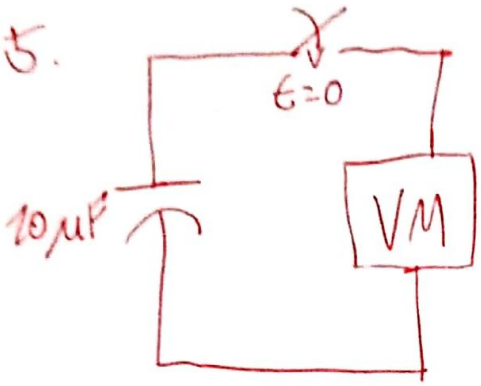
$W_B = \frac{1}{2} L I^2$

$C: I = C \frac{dV}{dt}$

$B: V = L \frac{dI}{dt}$

$W_{C1} = \frac{1}{2} \times 1 \times 12^2 = 72\,J$

5.



$t=0$ — $50V = V_i^0$ $\quad R=?$ RC Descarga

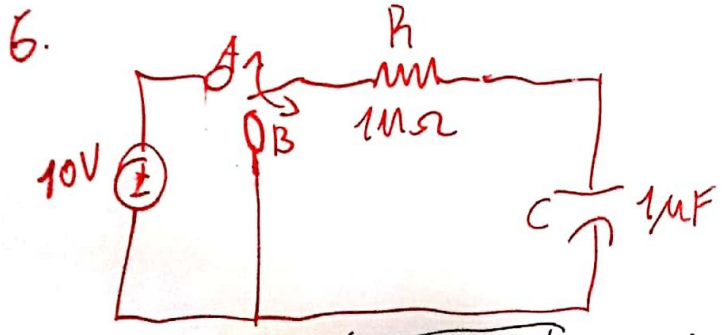
$t=30$ — $25V$

$V_C(t) = V_i^0 e^{-t/RC}$

$25 = 50 \times e^{-30/10.10^{-6} \times R} \Leftrightarrow \frac{1}{2} = e^{-30/10.10^{-6} \times R} \Leftrightarrow$

$\Leftrightarrow \frac{-30}{10.10^{-6} \times R} = \ln(\frac{1}{2}) \Leftrightarrow R = \frac{-30}{10.10^{-6} \times \ln(\frac{1}{2})} \Leftrightarrow R = 4{,}33 M\Omega$ //

6.



$t=0s$ C → descarregado

1–2 está a carregar

2–4 está a descarregar

$V_C(t) = V_s - V_s e^{-t/RC}$ (carga)

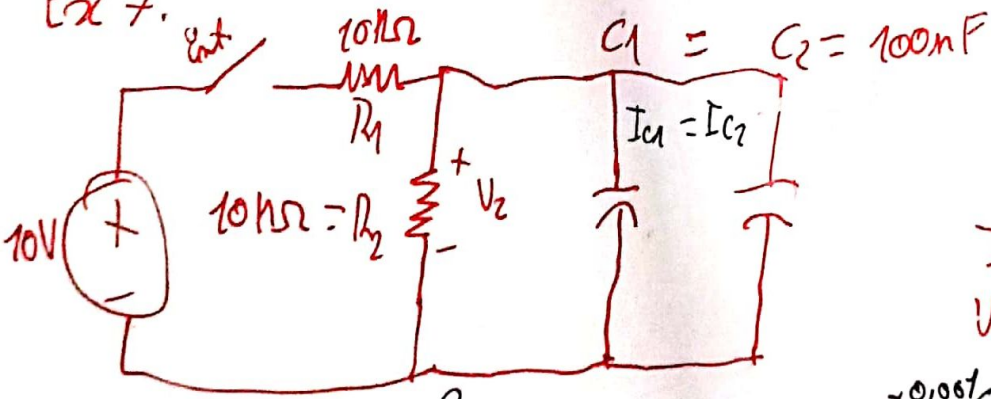
$V_C(t) = V_i^0 e^{-t/RC}$ (descarga)

$V_C(2) = 10 - 10 e^{-2/1.10^6 \times 1.10^{-6}} \Leftrightarrow$

$\Leftrightarrow V_C(2) = 8{,}65 V$ //

$V_C(4) = 8{,}65 e^{-2/1} \Leftrightarrow V_C(4) = 1{,}17 V$ //

Ex 7.



V_2?

I_{R_1}? V

I_{C_1}? V

W_{C_2}? $= \frac{1}{2} C V^2$

$V_2 = V_{C_1} = V_{C_2}$

$C_{eq} = 200nF$

$t=0s \quad V_2 = 10 \times \frac{10.10^3}{20.10^3} = 5V \qquad V_2(0{,}001) = 5 \times e^{\frac{-0{,}001}{200.10^{-9} \times 10.10^3}}$

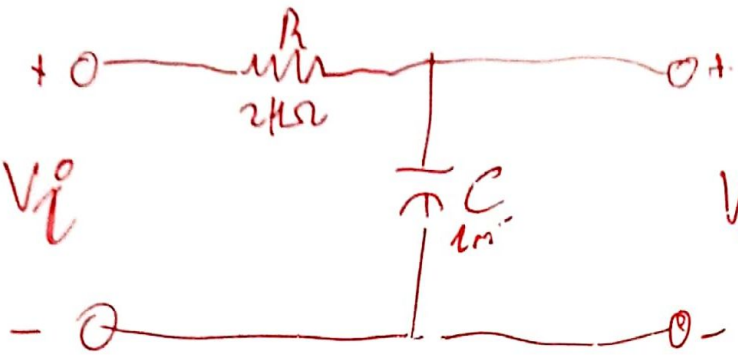
$= 3{,}03 V$? 3,16

$I_{R_1} = \frac{10 - 3{,}16}{10.10^3} = 684.10^{-6} = 684 \mu A$

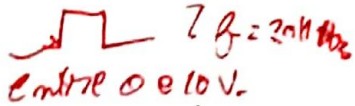
$684.10^{-6} = 2I ? \frac{3{,}16}{10.10^3} \Leftrightarrow I = 368.10^{-6} = I_{C_1} = 368 \mu A$

$W_{C_2} = \frac{1}{2} 100.10^{-9} \times (3{,}16)^2 = 5.10^{-7} J = 0{,}5 \mu J$

8.?

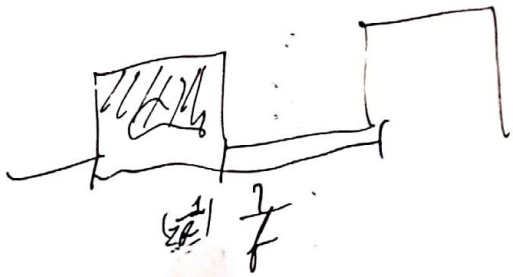


$V_o = V_i \cdot \frac{Z_c}{Z_1 + Z_c} =$

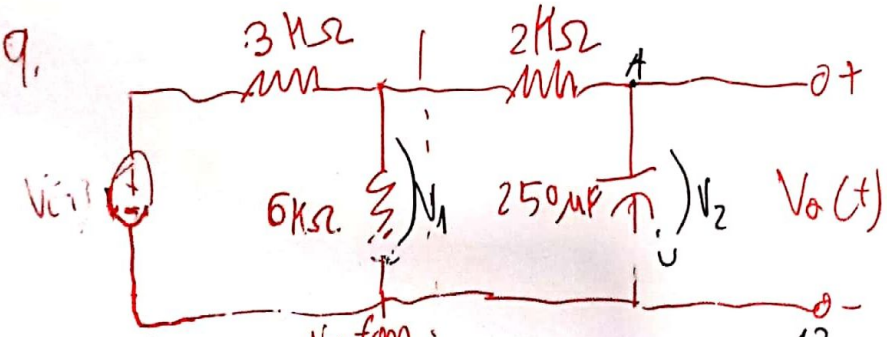
V_i =  ? $f = 2mHz$
entre 0 e 10 V.

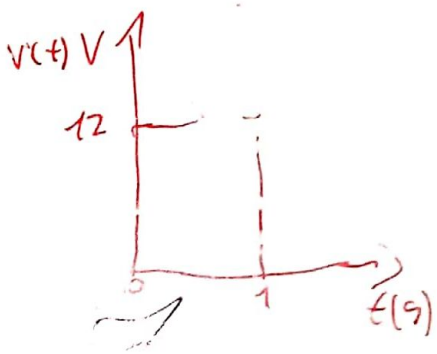
$V_i = V_{ef}$ $\quad T = \frac{1}{f}$

$V_{ef} = f \int_0^{T_2} 10^2 \, dt =$



9.





$V_o(t) = V_2$

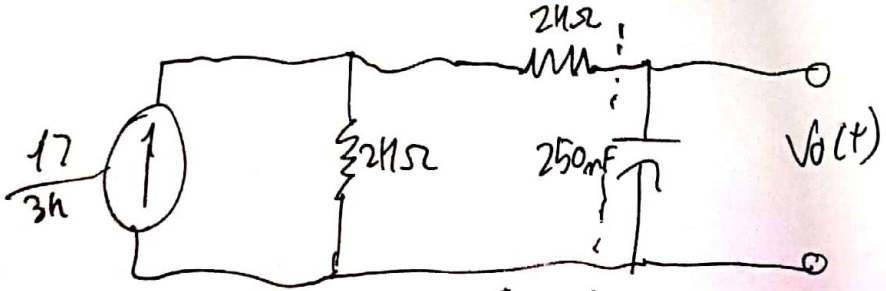
carga (0-1) descarga (1-2)

$V_2(1) = V_{A(0-1)} \times \left(1 - e^{\frac{-t}{RC}}\right)$

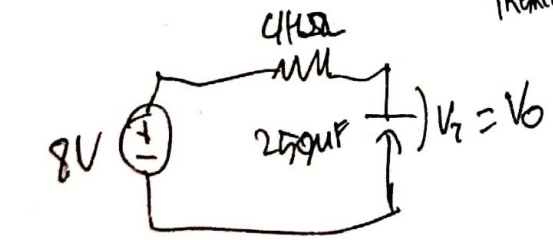
Norton.

$I_N = \frac{12}{3M\Omega}$

$R_N = (3 // 6) = 2M\Omega$



Thevenin.



$V_T = \frac{12}{3M} \times 2M = 8V$

$R_T = 4M\Omega$

$V_o(1) = 8 \times \left(1 - e^{\frac{1}{4.10^3 \times 250.10^{-6}}}\right) \approx 5,1\ V$ //

$V_o(2) = 5,1 \times e^{\frac{-1}{RC}} = 1,9V$ //

Trabalho Prático 2: PT1

$f_c = \frac{1}{2\pi RC} \Leftrightarrow 16\,Hz$

$V_0 = V_i \frac{Z_c}{Z_R + Z_c}$ (?) $\frac{V_0}{V_i} = \frac{Z_c}{Z_R + Z_c}$

$Z_c = \frac{1}{j\omega C}$; R

$= \frac{1}{\sqrt{1+(f/f_c)^2}}$

$= \frac{1}{\sqrt{1+(\frac{1}{16})^2}} \simeq 1$

$\frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{1}{j\omega RC + 1}$

$\angle H(f) = -\arctan\left(\frac{1}{16}\right) = 3{,}6°$

$V_0 = V_1 \frac{Z_R}{Z_R + Z_C}$

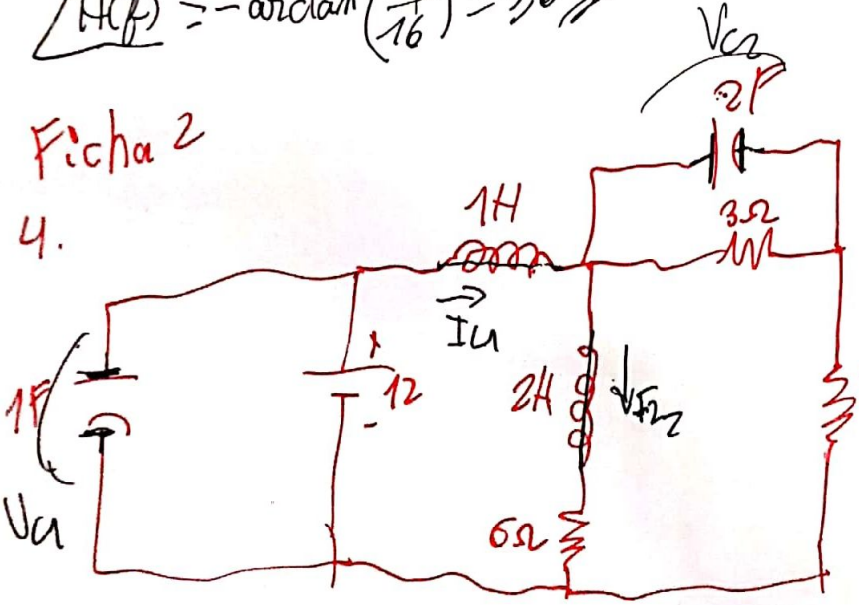
$H(f) = \frac{V_0}{V_1} = \frac{j(f/f_c)}{1 + j(f/f_c)}$

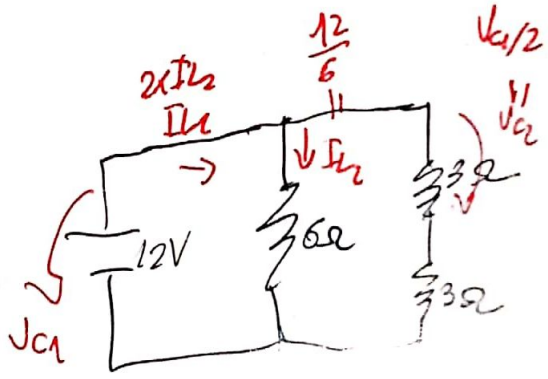
$|H(f)| = \frac{f/f_c}{\sqrt{1+(f/f_c)^2}} \simeq 0{,}06$

$\angle H(f) = 90° - \arctan\left(\frac{f}{f_c}\right) \simeq 86{,}4°$

Ficha 2

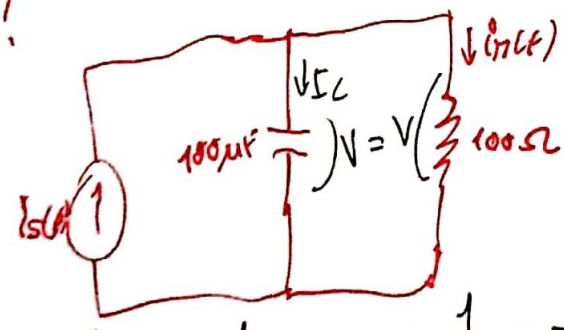
4.





VAR

10.?



$i_s(t) = 1\cos(200\pi t)$

$i_{s1}(t) = i_s(t) \times \frac{Z_c}{Z_c + Z_R}$

$I_S = I_C + I_R$

$i_s = 1\angle 0°$

$i_{s2} = \frac{V_{eq}}{R}$

$Z_C = \frac{1}{j\omega C} = \frac{1}{j \times 200\pi \times 100 \cdot 10^{-6}} = \frac{1}{2\cdot 10^{-2}\pi j} = -j\,15{,}9\,\Omega$

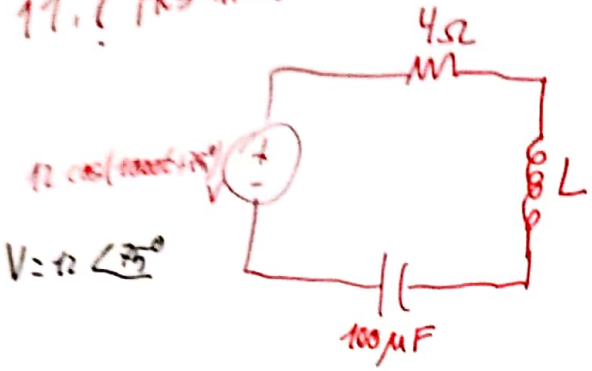
$\frac{1}{Z_{RC}} = \frac{1}{\frac{1}{100} + 2\pi 10^{-2} j}$ $= \sqrt{0{,}01^2 + 4\pi^2 \times 10^{-4}} = 0{,}064\,\angle 81°\,\Omega$

$\arctg\left(\frac{2\pi \cdot 10^{-2}}{0{,}01}\right) \simeq 81°$

$V_{2eq} = 1\angle 0° \times 0{,}064\angle 81°$

$= 0{,}064\angle 81°$

11.? mes mal.



$V = 1 \angle 75°$

$Z_L = j\omega L = j \times 1000 \times L\ \Omega$ $\quad \phi = \tan^{-1}\left(\frac{\text{Imaginary}}{\text{Real}}\right)$

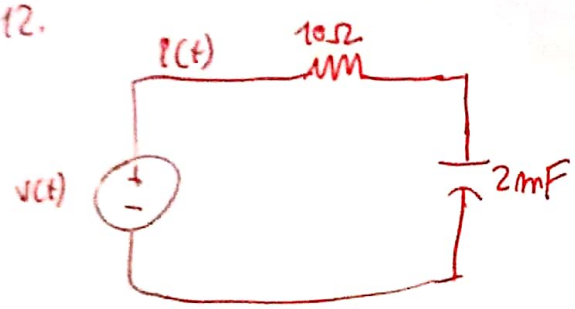
$Z_C = -j \times \frac{1}{1000 \times 100 \cdot 10^{-6}} = -j \times 10\ \Omega$

$Z_{eq} = 4 + j \times 1000 \times L - 10j$

$= 4 + j(1000L - 10)$

$75° = \arctg\left(\frac{1000L - 10}{4}\right) \Leftrightarrow tg\,75° \times 4 = 1000L - 10 \Leftrightarrow L = \frac{(tg\,75 \times 4) + 10}{1000} \Leftrightarrow L = 24{,}9\ mH$ //

12.



$V(t) = 25\cos(\omega t) = 25 \angle 0°$

$Z_C = \frac{1}{\omega \times 2 \cdot 10^{-3}} \times (-j) = -j \times \frac{1}{\omega} \times 500\ \Omega$

$Z_{eq} = 10 - \frac{500}{\omega} j = 10 - \frac{250}{\pi f} j = \sqrt{10^2 + \left(\frac{250}{\pi f}\right)^2}$

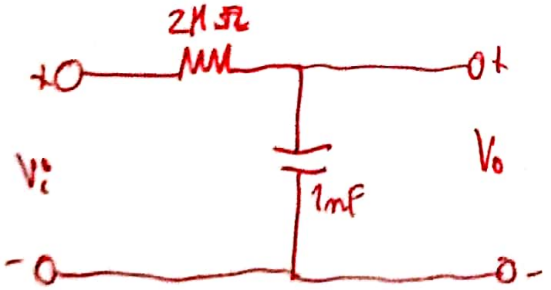
$= \sqrt{100 + \left(\frac{62500}{\pi^2 f^2}\right)}$

$V = Z \times I = 2$

$25 \angle 0° = 2 \times \sqrt{100 + \frac{62500}{\pi^2 f^2}} \angle \arctg\left(\frac{-500}{10(\pi f)}\right) \Leftrightarrow$

$\Leftrightarrow 12{,}5^2 = 100 + \frac{62500}{\pi^2 f^2} \Leftrightarrow \frac{12{,}5^2 - 100}{62500} = \frac{1}{\pi^2 f^2} \Leftrightarrow f = \sqrt{\frac{62500}{(12{,}5^2 - 100)\pi^2}} \simeq 10{,}6\ Hz$ //

13.?



$V_i = 14{,}1 \cos(2\pi \times 800 \cdot 10^3 t)$

$V_o\ ef = ?$

$Z_C = -j \times \frac{1}{10^{-9} \times 2\pi \times 800 \cdot 10^3} = -198{,}9j\ \Omega$

$Z_{eq} = 2 \cdot 10^3 - 198{,}9j = 2{,}01 \cdot 10^3 \angle -5{,}7°$

$I = \frac{14{,}1 \angle 0}{2{,}01 \cdot 10^3 \angle -5{,}7} \simeq 7 \cdot 10^{-4} \angle 5{,}7\ A$

$V_o = 7{,}1 \cdot 10^{-4} \angle 5{,}7 \times (198{,}9 \angle -90)$

$= 0{,}14 \angle -84{,}3$ //

C.A.

$\sqrt{(2 \cdot 10^3)^2 + (198{,}9)^2} = 2{,}01 \cdot 10^3$

$\arctg\left(\frac{-198{,}9}{2 \cdot 10^3}\right) = -5{,}7°$