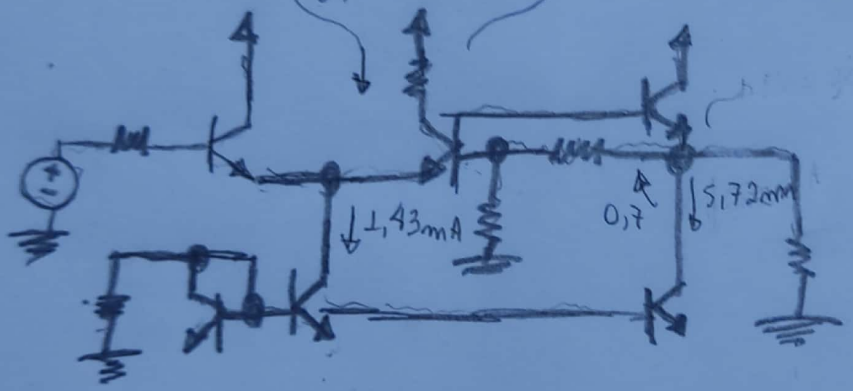
→ cálculo

(1)

∴ calculando a corrente do circuito

corrente 1 $\left\{ \frac{15 - 0,7}{10K} \right\}^{14,3} = 1,43 \cdot 10^{-3} = 1,43\,mA$ $\left\{ \left(\frac{15 - 0,7}{10K} \right) \cdot 4 \right.$ corrente 2 $I = 5,72\,mA$



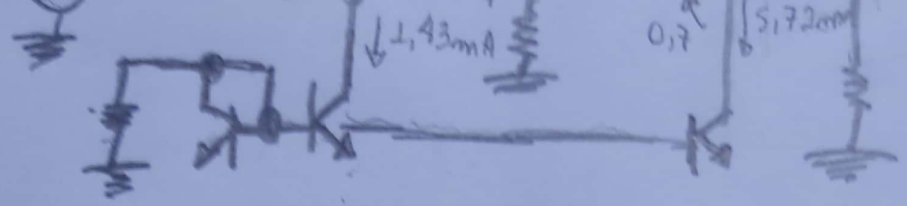
Desenhando o circuito sem os valores p/ ilustrar a resolução!

$I_C = \frac{1,43\,m}{2} = 0,715\,m$

∴ calculando Re

→ valor nominal do diodo / Tensão Termica

$Re = \frac{V_T}{I_C}$ $\left\{ Re_2 = \frac{25\,mV}{0,715\,mA} = 34,96\,\Omega \right\}$ e $Re_1 = \frac{25\,mV}{}$



Circuito sem os valores p/ ilustrar a resolução!

$$I_C = \frac{1,43m}{2} = 0,715m$$

∴ calculando Re

→ valor nominal do diodo / Tensão Termico

$$Re = \frac{V_T}{I_C}$$

$$Re_2 = \frac{25mV}{0,715mA} = 34,96\Omega$$ e $Re_1 = 25m$

$I_{C_1} = 0,715m$, $I_{C_2} = 5,72$

4

Porque divide por 2!

$$re_1 = \frac{25mV}{5,72mA} = 4,37\Omega$$

... continuando o cálculo de R_0

$$R_0 = \frac{33,91 \cdot 7,076K}{33,91 + 7,076K} \cong 33,75\ \Omega = R_0$$

.... Ganho

$$A_0 = \frac{R_{in}}{R_{in} + 10K} \cong 0,83 = A_0$$

$A = A_0 \cdot A_1$ → fator $A_0 = 1 + A \cdot \beta$

$$R_{in_2} = [10K \,//\, 24,2K + 4,37](B+1) = 4,8M$$

$r_c = 20 \,//\, R_{in2} \cong 20K\Omega$

$R_{bb} = 2 \cdot 34,96 \cdot 677$

$R_{bb} = 88K$

$$V_0 = \frac{V_{bb}}{2r_e} \cdot R_c' = \frac{V_0}{V_{bb}} = \frac{R_c'}{2r_e}$$

$$A_1 = \frac{R_c'}{2R_e} \cdot \left(\frac{R_{bb}}{R_{bb} + 2K} \right) \cong 280$$

$1 + 19,306 = 20,306$

$$A_F = \frac{A}{\text{Fator}} \cong 11,6$$

↑

$R_{in_F} = 192K\Omega$

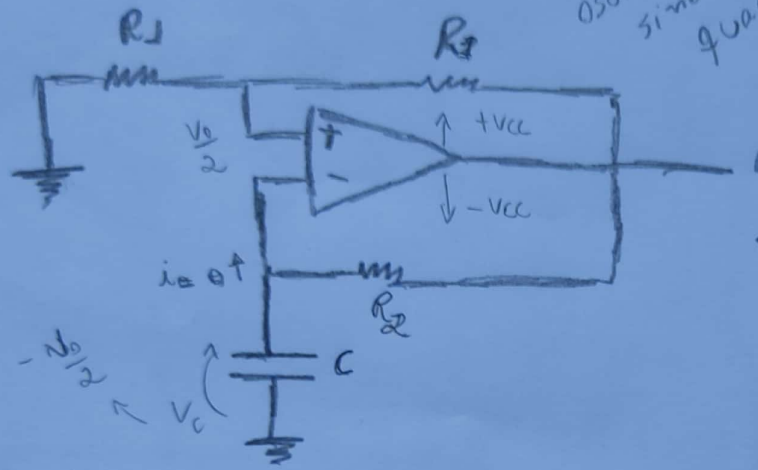
$$R_{OF} = \frac{33,75}{20,306} = 1,66\ \Omega$$

① - Vantagens e desvantagens da Alimentação Negativa

Vantagens
- Estabilização no ganho
- Redução da distorção não Linear
- Redução do efeito do ruído
- Controle das impedâncias de entrada e saída
- Extensão da Largura de banda

Desvantagens
- Diminuição do ganho
- Tendência à oscilações

② .



oscilador de sinal quadrado

multivibrador

Circuito de carga e descarga de um capacitor

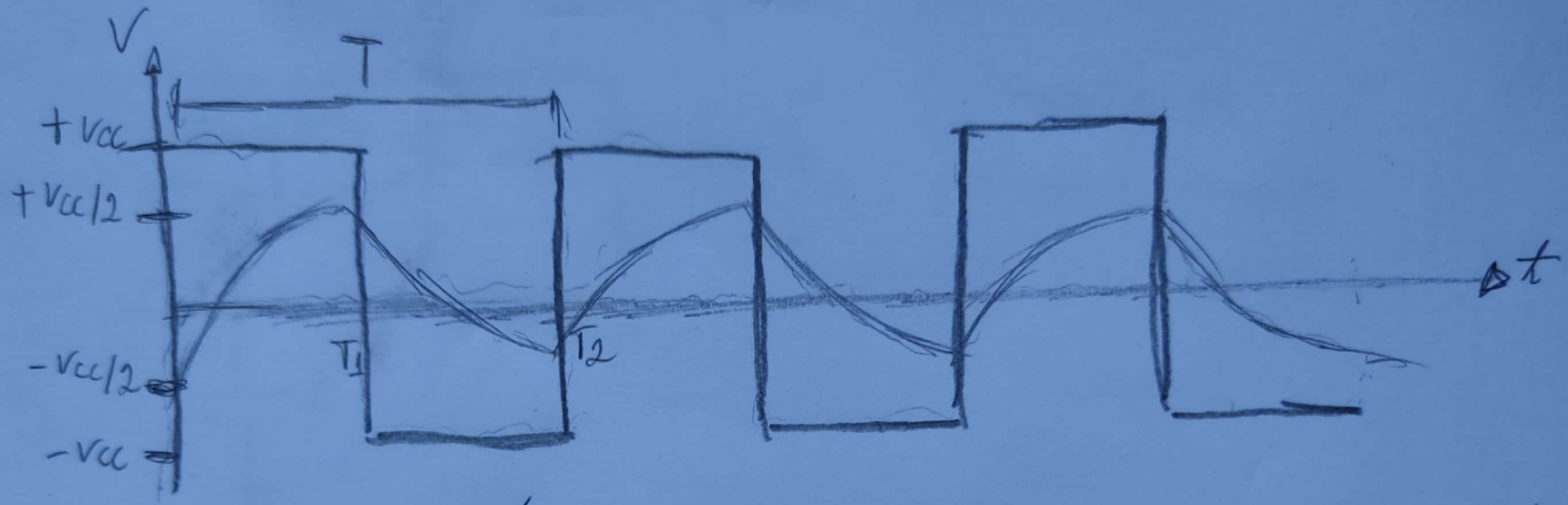
Nesse circuito, temos que supor condições iniciais, necessárias.

Ex: $V_0 = V_{CC}$

$V_C = \frac{V_{CC}}{2}$ ← Tensão do capacitor (V-)

O funcionamento de um capacitor se dá, com um circuito RC alimentado por uma tensão de saída, até que a tensão no capacitor (v-) seja maior $V_+ = V_{CC}/2$, $V_0 = [V(+) - V(-)] . A = -V_{CC}$, quando isso acontece, o capacitor começa a descarregar, até que V_0 se torne igual a V_{CC} [$V_0 = V_{CC}$], e o processo se repete.

(2 ... continuando a questão 2.



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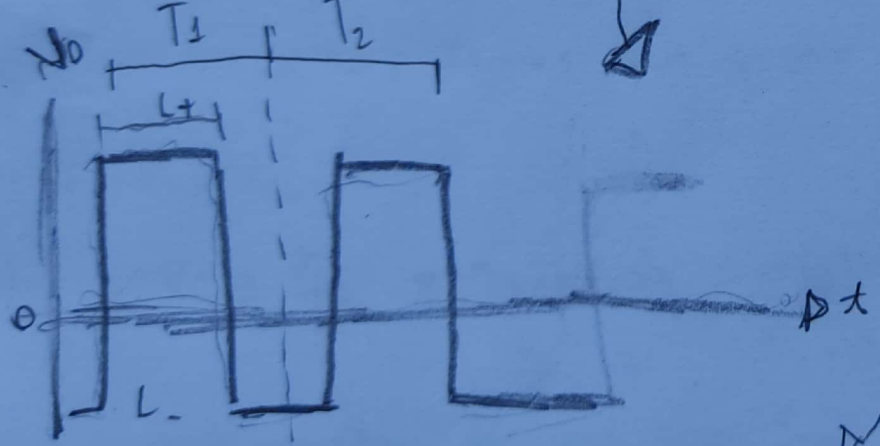
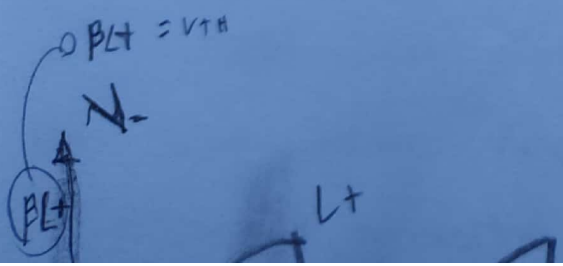




Para T_1

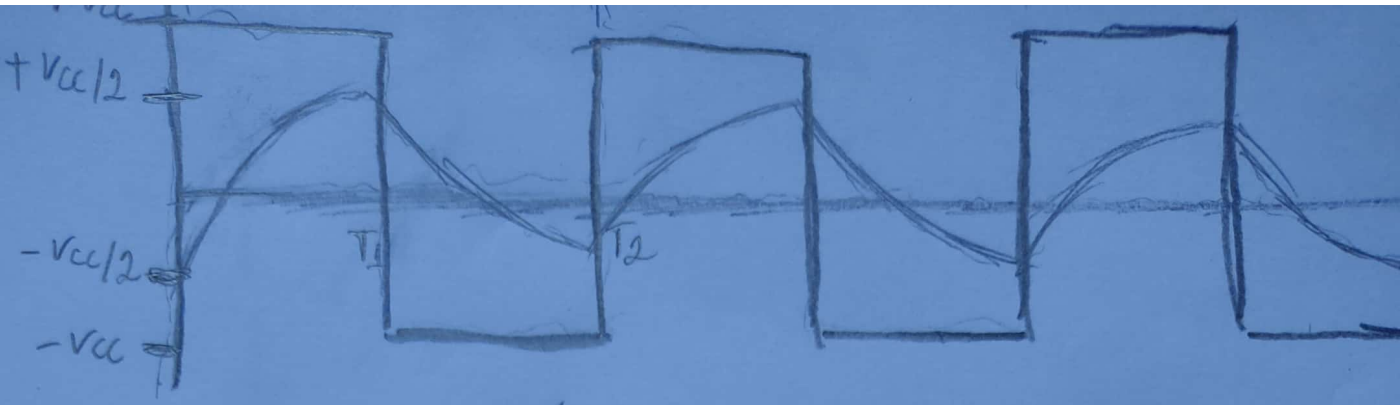
$$V_{C_1}(t) = V_f + (V_c - V_f) \cdot e^{-t/RC}$$

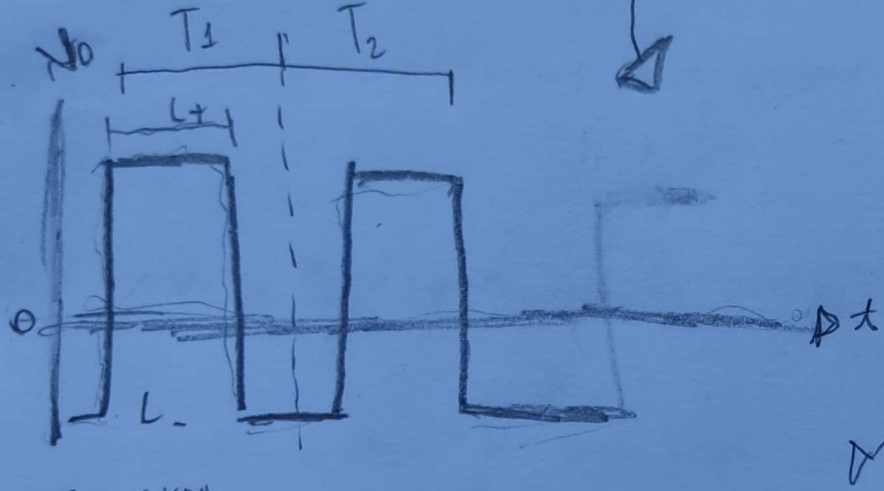
$$\Rightarrow V_0 + \left(\frac{V_0}{2} - V_0\right) \cdot e^{-t/RC}$$

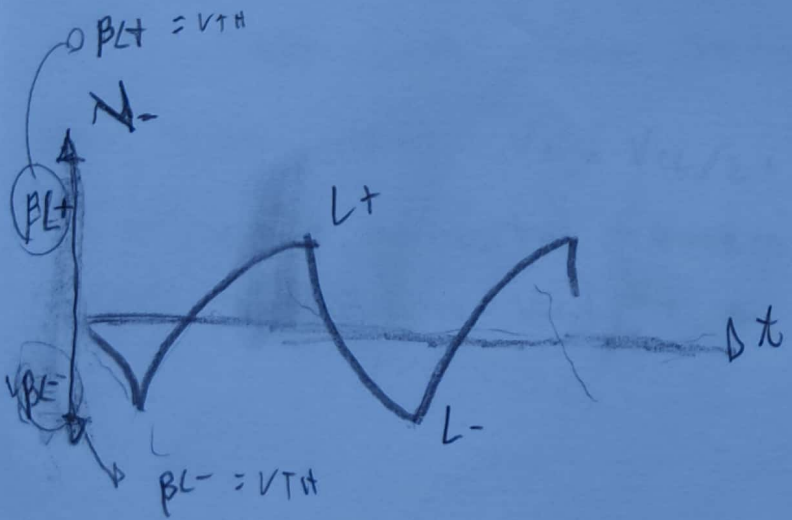
$$\Rightarrow \frac{V_0}{2} = V_0 - \frac{3}{2} V_0 \cdot e^{-T_1/RC}$$

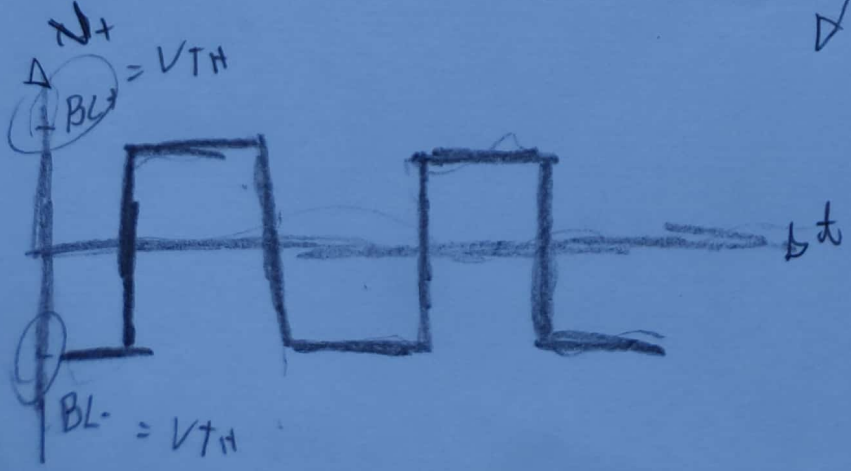
$$\Rightarrow \frac{-1}{2} = \frac{-3}{2} \cdot e^{-T_1/RC}$$

$$\Rightarrow e^{-T_1/RC} = 1/3$$









Para T_1

$V_{C_1}(t) = V_f + (V_c - V_f)$

$\Rightarrow V_0 + \left(\frac{V_0}{2} -$

$\Rightarrow \frac{V_0}{2} = V_0 - \frac{3}{2}$

$\Rightarrow \frac{-1}{2} = \frac{-3}{2}$

$\Rightarrow e^{-T_1/RC}$

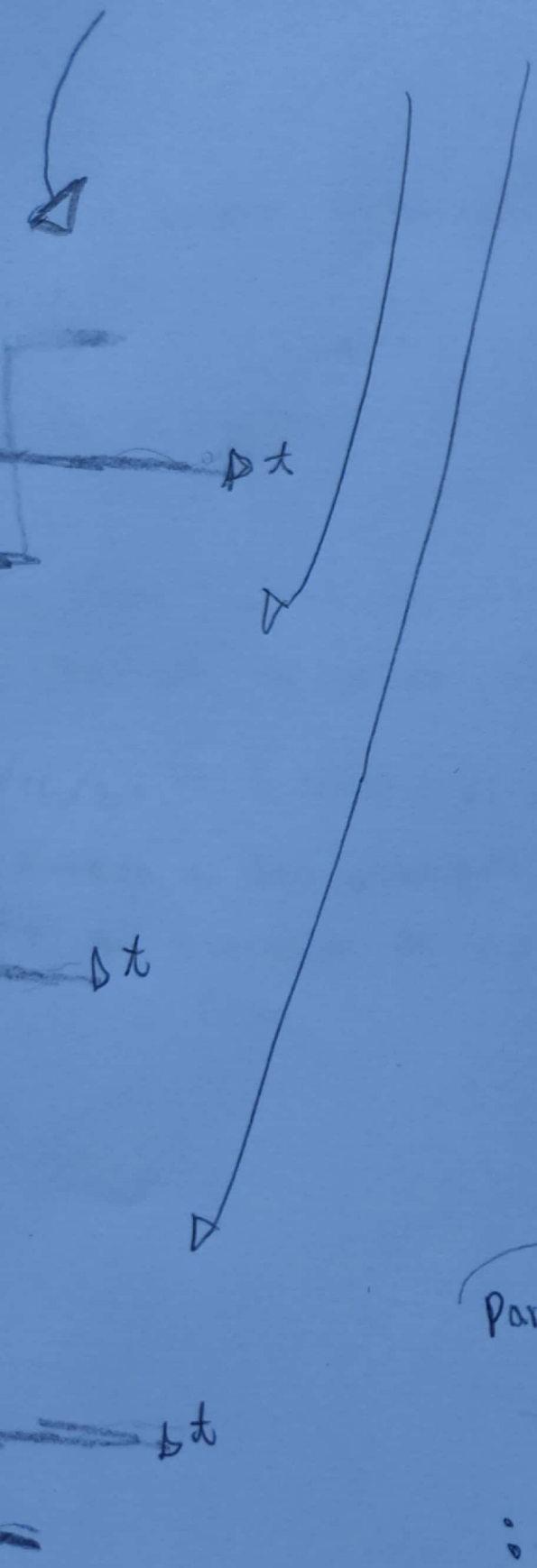
$T_1 = -\ln$

$T_1 =$

Para T_2 → utilizo Lógica

$\therefore V_{C_2}(t) = -V_0 + \left(\frac{V_0}{2}$

$T_2 = RC \ln(3$



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$$\Rightarrow \frac{-1}{2} = \frac{-3}{2} \cdot e^{-T_1/RC}$$

$$\Rightarrow e^{-T_1/RC} = 1/3$$

$$T_1 = -\ln\left(\frac{1}{3}\right) \cdot RC$$

$$\boxed{T_1 = RC \ln(3)}$$

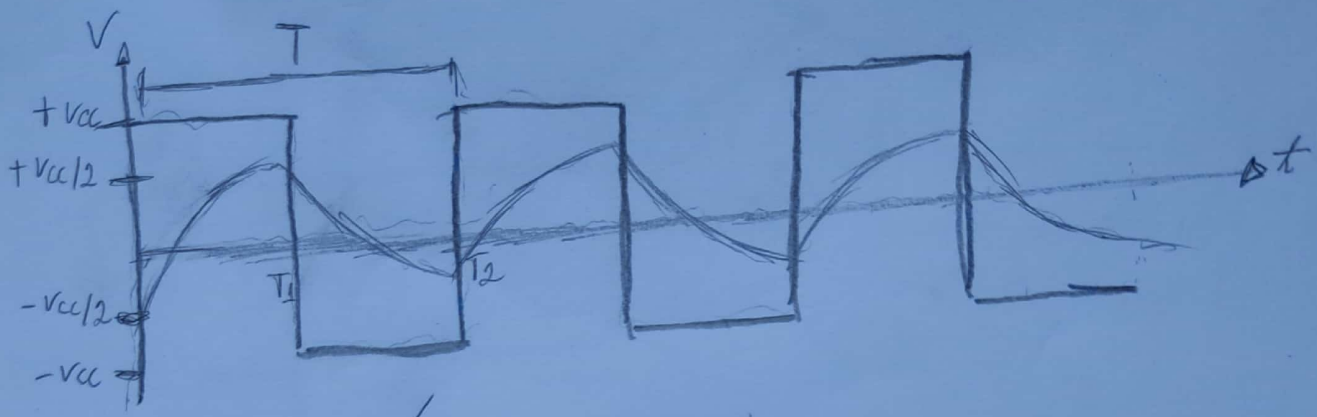
Para T_2 → utilizando a mesma lógica de T_1

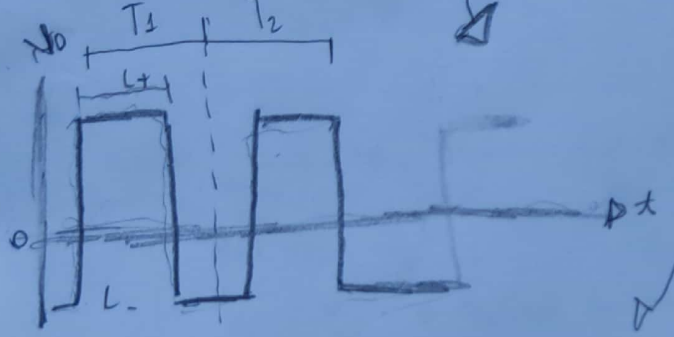
$$\therefore V_{C_2}(t) = -V_0 + \left(\frac{V_0}{2} + V_0\right) \cdot e^{-t/RC}$$

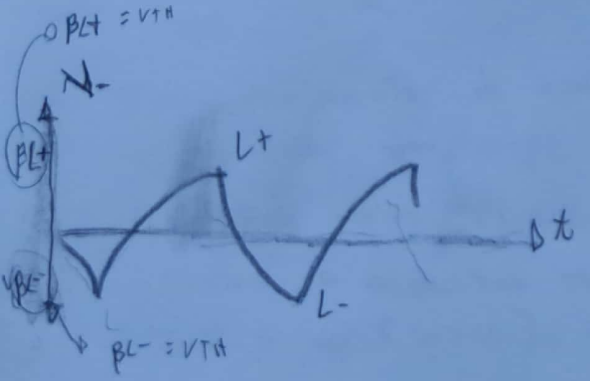
$$\vdots$$

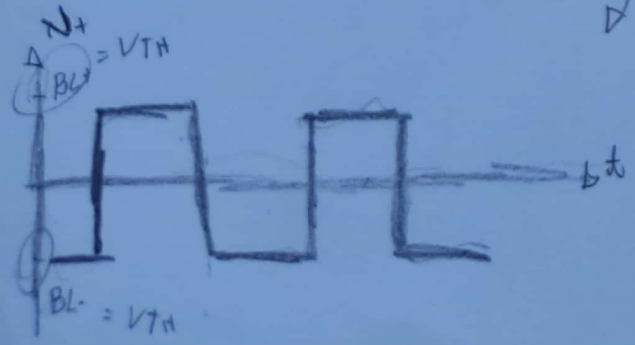
$$\boxed{T_2 = RC \ln(3)}$$

... continuando a questão 2.









Para T_1

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$$T_1 = -\ln\left(\frac{1}{3}\right) \cdot RC$$

$$\boxed{T_1 = RC \ln(3)}$$

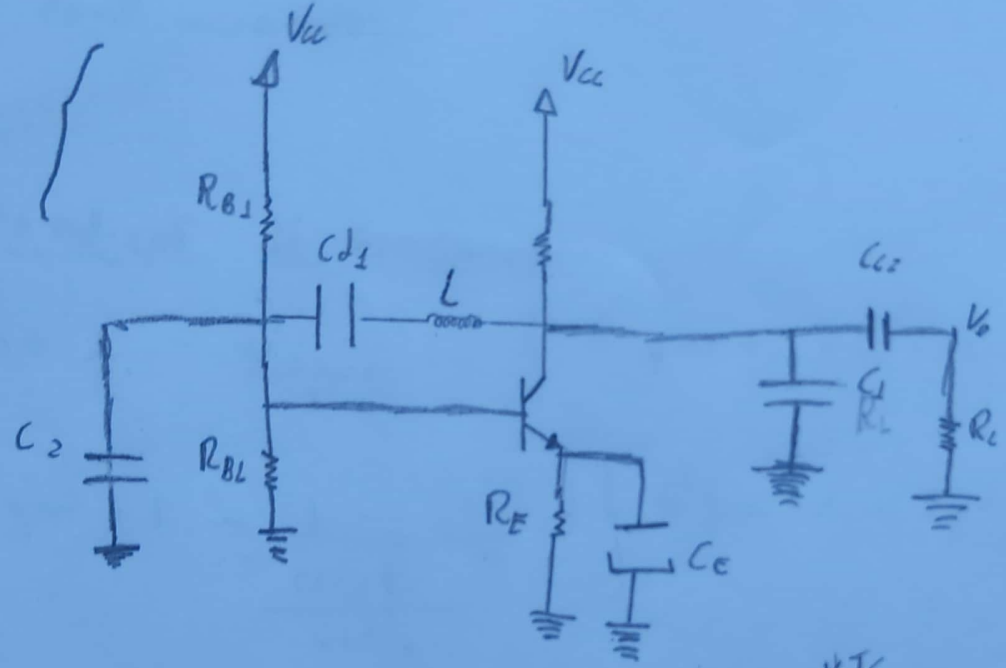
Para T_2 → utilizando a mesma lógica de T_1

$$\therefore V_{C_2}(t) = -V_0 + \left(\frac{V_0}{2} + V_0\right) \cdot e^{-t/RC}$$

$$\vdots$$

$$\boxed{T_2 = RC \ln(3)}$$

③ Desenhando Novamente



Dados

$R_{B1} = 498\,K\Omega$

$R_{B2} = 93\,K\Omega$

$R_E = 1\,K\Omega$

$R_C = 4{,}7\,K\Omega$

$R_L = 4{,}7\,K\Omega$

$Cd_1, C_{C1}, C_{C2}, C_e = 10\,\mu F$

$C_1 = 15\,nF$

$C_2 = 455\,nF$

$L_1 = 10\,\mu H$

$\beta = 676$

$V_B = 1{,}44\,V$

$V_E = 0{,}792\,V$

$V_C = 6{,}285$

KT/q

$V_{CC} = 10\,\mu V$

$V_T \simeq 2{,}5\,mV$

$$g_m = \frac{I_C}{V_T} \quad ; \quad I_C = \frac{V_{CC} - V_C}{R_C}$$

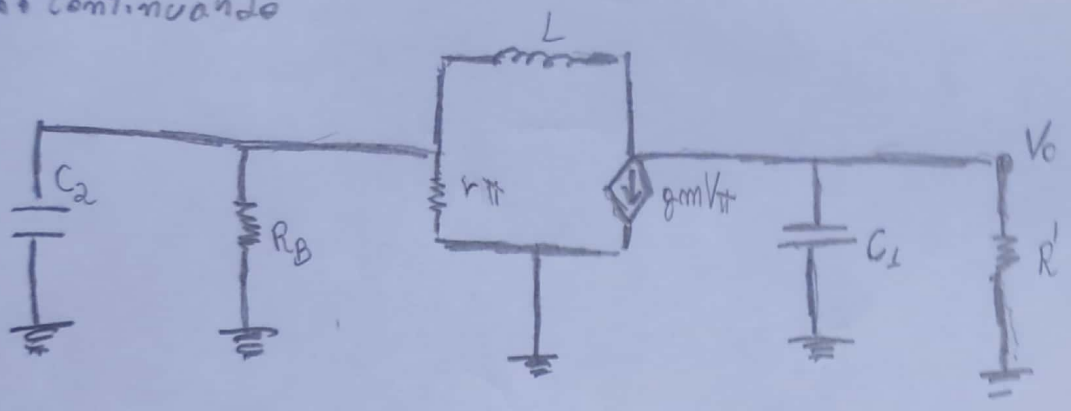
$$I_C = \frac{10 - 6{,}285}{4700} = 0{,}8\,mA$$

$$g_m = \frac{0{,}8\,m}{2{,}5\,m} \simeq 0{,}316\,A/V$$

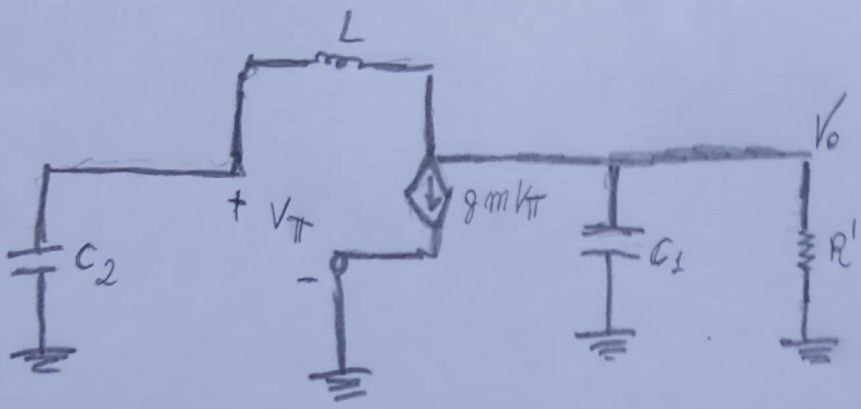
$I_C = 0{,}8\,mV$

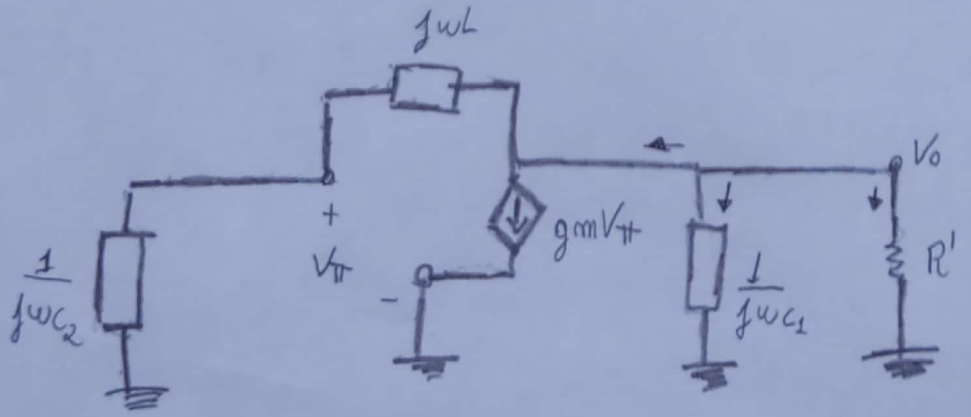
$g_m = 0{,}316\,V$

... Continuando



Impedância de $C_2 \ll\ll V_\pi // R_B$





$$V_\pi j\omega C_2 + g_m V_\pi + V_o\left(j\omega C_1 + \frac{1}{R'}\right) = 0$$

$$V_o = V_\pi + V_\pi j\omega C_2$$

$$W_L = V_\pi\left(1 - \omega^2 L C_2\right)$$

$$\therefore V_\pi j\omega C_2 + g_m V_\pi + V_\pi\left(1 - \omega^2 L C_2\right).\left(j\omega C_1 + \frac{1}{R'}\right) = 0$$

$$\rightarrow \left(g_m + \frac{1 - \omega^2 C_2 L}{R'}\right) + j\left(\omega(C_1 + C_2) - \omega^3 C_1 C_2 L\right)$$

... continuando

Condição de Oscilação

$$g_m + \frac{1}{R'} - \frac{\omega^2 C_2 L}{R'} = 0 \quad \Big\} \quad R' g_m + 1 - \omega^2 C_2 L = 0$$

$$\rightarrow R' g_m + 1 - \frac{1}{\frac{C_1 C_2 L}{C_1 + C_2}} \cdot C_2 L = 0 \quad \Big\} \quad R' g_m + 1 - \frac{C_1 + C_2}{C_1} = 0$$

$$\rightarrow R' g_m - \frac{C_2}{C_1} = 0 \quad \Big\} \quad \frac{C_2}{C_1} = R' g_m \quad \Rightarrow \boxed{g_m R' \geq \frac{C_2}{C_1}}$$

$$\Rightarrow g_m R' = 73{,}3 \quad e \quad \frac{C_2}{C_1} = 29{,}667 \text{, Logo} \Rightarrow \boxed{\text{OSCILA}}$$

Frequência da Oscilação

$$j\omega C_2 + g_m + (1 - \omega^2 C_2 L) \cdot \left(j\omega C + \frac{1}{R'}\right) = 0$$

$$\rightarrow j\omega C_2 + g_m + j\omega C_1 + \frac{1}{R'} - j\omega^3 C_1 C_2 L - \frac{\omega^2 C_2 L}{R'} = 0$$

$$\omega_0 (C_1 + C_2) - \omega_0^3 C_1 C_2 L = 0 \quad \Big\} \quad \omega_0^2 = \frac{C_1 + C_2}{C_1 C_2 L} = \frac{1}{\frac{C_1 C_2 L}{C_1 + C_2}} = \frac{1}{C_{eq} L}$$

$\therefore$

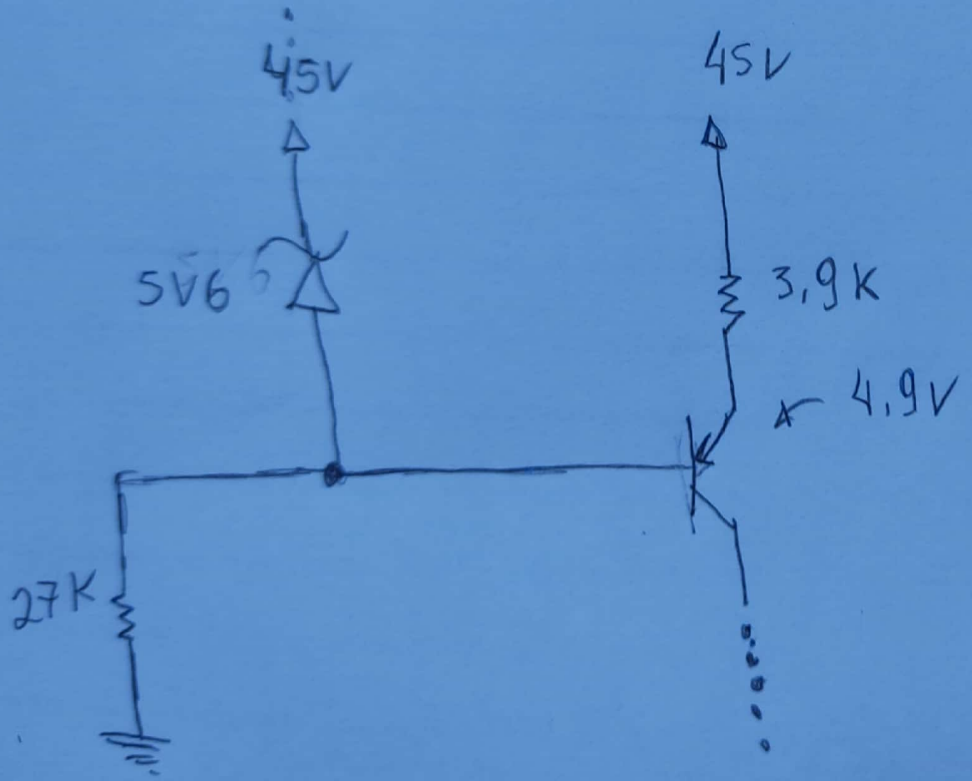
$$\omega_0^2 = \frac{1}{C_{eq} L} \rightarrow \boxed{\omega_0 = \frac{1}{\sqrt{C_{eq} L}}}$$

$$\rightarrow \omega_0 = 2{,}6\,M \text{ rad/s}$$

$$\boxed{\omega_0 = 417{,}8\,KHz}$$

④

a) ... Coletor 2

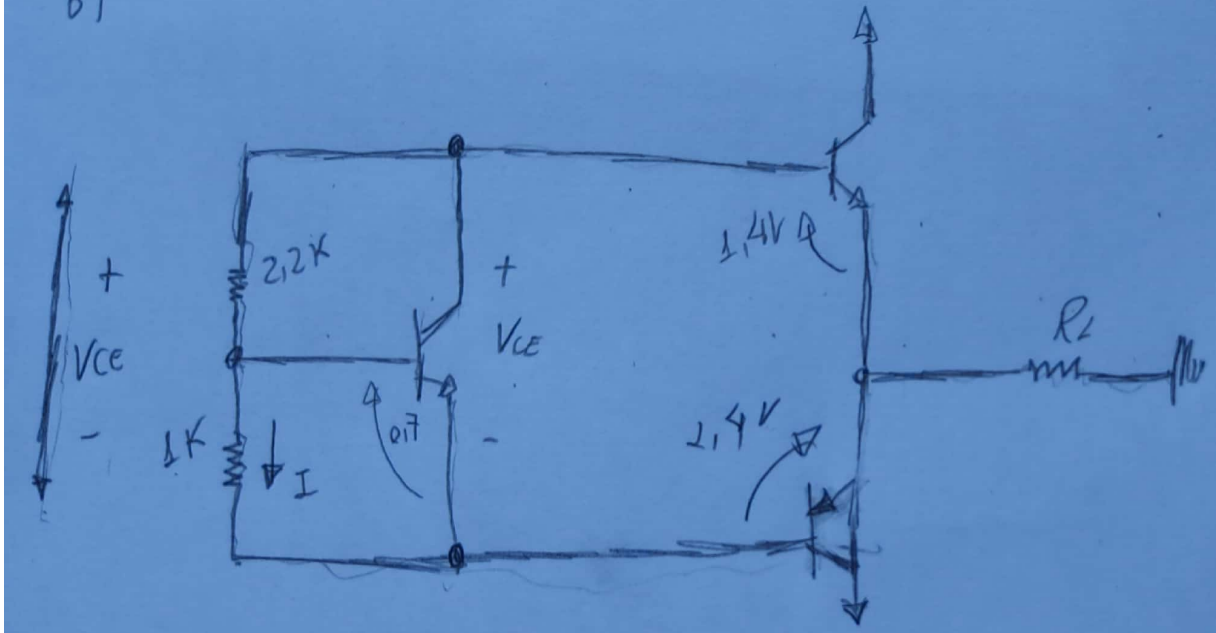


$$I_C = \frac{(5,6 - 0,7)}{3900} = 1,26\,mA$$

(4,9)

$$I_C = 1,26\,mA$$

b)



$$I = \frac{0,7}{1000} = 0,7\,mA$$

$$V_{CE} = 3.200 \cdot 0,7 \cdot 10^{-3}$$

$$V_{CE} = 2,24\,V$$

O Transistor "T_{14}" realiza a função de multiplicador de Tensão, Fornecendo uma tensão Fixa afim de pré-polarizar os Transistores de potência.