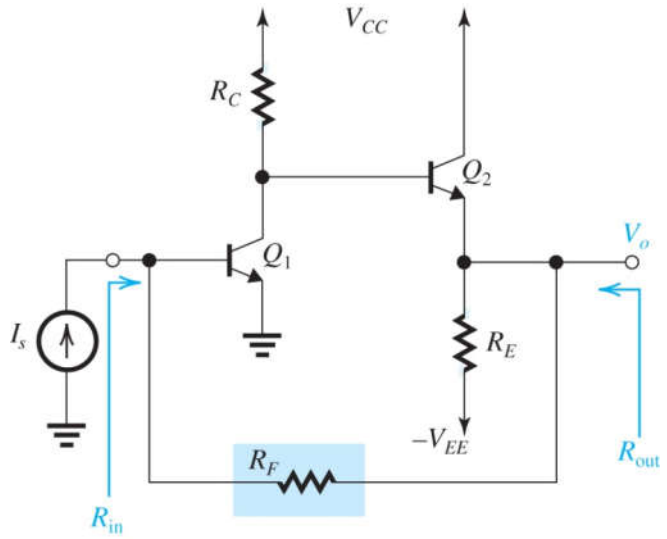
Resolução Exercício 9 - CEA



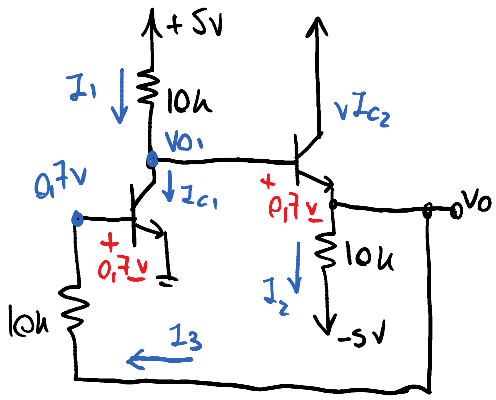
→ $V_{CC} = V_{EE} = 5V$;

$R_C = R_E = R_F = 10k\Omega$

$\beta = 100$

a) Realimentação Paralelo - Paralelo

b) Definir a polarização:



- $V_{O1} = V_O + 0{,}7V$; $I_3 = I_{B1} = \frac{I_{C1}}{\beta}$

$I_{C1} = I_1 - I_{B2}$

$I_{E2} = I_2 + I_3$

→ $I_1 = \frac{5 - V_O - 0{,}7}{10k}$

$I_2 = \frac{V_O + 5}{10k}$; $I_3 = \frac{V_O - 0{,}7}{10k}$

→ Assim,

$\beta I_3 = I_1 - I_{E2}/\beta$

$\beta\left(\frac{V_O - 0{,}7}{10k}\right) = \frac{4{,}3 - V_O}{10k} - \frac{V_O + 5 + V_O - 0{,}7}{\beta \cdot 10k}$

$\beta^2(V_O - 0{,}7) = \beta(4{,}3 - V_O) - 2V_O - 4{,}3$

$V_O(\beta^2 + \beta + 2) = 430 - 4{,}3 + 7000$

$\boxed{V_O = 0{,}735V}$

$I_1 = 356{,}5\mu A$

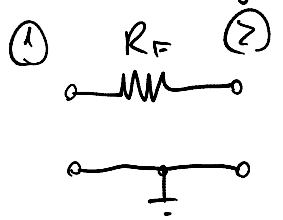
$I_2 = 573{,}5\mu A$

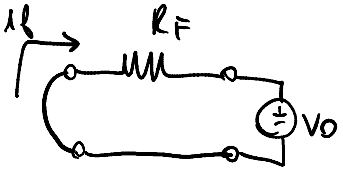
$I_3 = 3{,}5\mu A$

$\boxed{I_{C1} = 350{,}7\mu A}$

$\boxed{I_{C2} = 571{,}3\mu A}$

c) Calcular o ganho de realimentação





$$\beta = \frac{if}{Vo} = -\frac{1}{R_F}$$

$$\boxed{\beta = -\frac{1}{10k} = -0{,}1\ mA/V}$$

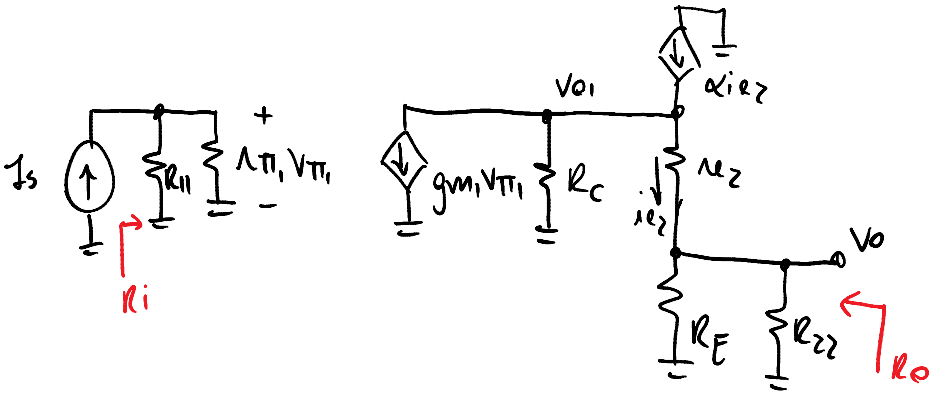
- $R_{11} = R_F$

$R_{22} = R_F$

d) Calcule o ganho A

$\rightarrow A = \frac{Vo}{is}$; $r_{\pi_1} = 7{,}13k\Omega$ $\quad r_{e2} = 43{,}33\Omega$; V_A não foi informado,

$g_{m_1} = 14\ mA/V$ $\quad \alpha = 0{,}99$ $\quad$ logo $r_{o_1} = r_{o_2} \rightarrow \infty$



$\rightarrow v_{\pi_1} = R_{11} // r_{\pi_1} \cdot is = 4{,}162\ kV/A \cdot is$

$$v_{o1} = -g_{m_1} v_{\pi_1} \cdot \left(R_C // \left(r_{e2} + R_E // R_{22} \right)(\beta + 1) \right) = -137{,}3\, v_{\pi_1}$$

$$v_o = v_{o1} \cdot \frac{R_E // R_{22}}{r_{e2} + R_E // R_{22}} = 0{,}9914 \cdot v_{o1}$$

$\rightarrow$ logo, $\boxed{\frac{Vo}{is} = -566{,}53\ kV/A}$

e) Calcular A_f, R_{in} e R_{out}

$$A\beta = -566{,}53\ kV/A \cdot -0{,}1\ mA/V = +56{,}65$$

$$A_f = \frac{A}{1+A\beta} = -9{,}83\ kV/A$$

$$R_i = R_{11} // R_{12} \simeq 4{,}162\ k\Omega$$

$$R_o = R_E // R_{22} // \left(R_2 + \frac{R_C}{\beta+1}\right) = 138{,}4\ \Omega$$

$$R_{if} = R_{in} = \frac{R_i}{1+A\beta} = 72{,}2\ \Omega$$

obs: $R_s = \infty$

$$R_{out} = R_{of} = \frac{R_o}{1+A\beta} = 2{,}4\ \Omega$$

obs: $R_L = \infty$