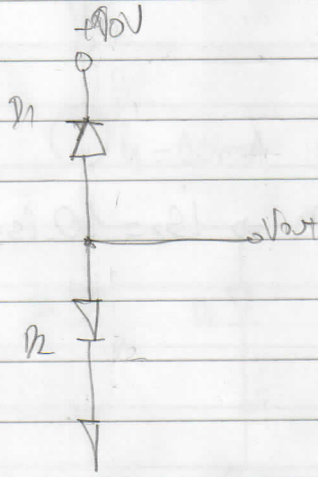


Exercício 4 Problema 3:

2)



$I_D = 1 \text{ mA}$, $N_D = 0,7 \text{ V}$, $\beta = 1$.

$A \ 25^\circ \text{C} \Rightarrow \begin{cases} N_{out} = 100 \text{ mV} \\ N_T = 26 \text{ mV} \end{cases}$

$$|I_{T1}| = -(I_{S1} + I_F) \approx I_{S1} + I_F \quad I_{D2} = I_S \left(e^{\frac{N_{D2}}{N_T}} - 1 \right) \approx I_S e^{\frac{N_{D2}}{N_T}}$$

$$I_{D1} = I_{D2} \Rightarrow d = e^{\frac{N_{D2}}{N_T}} \Rightarrow I_S = \frac{I_D}{d}$$

$$I_S = 20,30 \times 10^{-16} \text{ A}$$

com $N_{out} = 100 \text{ mV} \Rightarrow N_{D2} = N_{out}$

$$I_{D2} = I_S e^{\frac{N_{out}}{N_T}} \Rightarrow I_{D2} = 95,03 \times 10^{-15} \text{ A}$$

$$I_{D2} = I_S + I_F \Rightarrow I_F = I_{D2} - I_S$$

$$I_F = 9,30 \times 10^{-14} \text{ A}$$

$$\beta = \frac{I_F}{I_S} \Rightarrow \beta = 45,8$$

$$b) \quad i_s(50^\circ\text{C}) = i_s(T=25^\circ\text{C}) \cdot 2^{\left(\frac{50^\circ\text{C}-25^\circ\text{C}}{5^\circ\text{C}}\right)} \Rightarrow i_s(50^\circ\text{C}) = i_s(T=25^\circ\text{C}) \cdot 32$$

$$\boxed{i_s(50^\circ\text{C}) = 6,50 \times 10^{-14} \text{ A}}$$

$$i_f(50^\circ\text{C}) = i_f(25^\circ\text{C}) \cdot 2^{\left(\frac{50^\circ\text{C}-25^\circ\text{C}}{10^\circ\text{C}}\right)} \Rightarrow i_f(50^\circ\text{C}) = 2^{5/2} i_f(25^\circ\text{C})$$

$$\boxed{i_f(50^\circ\text{C}) = 5,26 \times 10^{-13} \text{ A}}$$

$$\Rightarrow i_{T1}(50^\circ\text{C}) = i_s(50^\circ\text{C}) + i_f(50^\circ\text{C})$$

$$\boxed{i_{T1}(50^\circ\text{C}) = 5,91 \times 10^{-13}}$$

$$\Rightarrow \boxed{i_{O2}(50^\circ\text{C}) = i_{T1}(50^\circ\text{C})}$$

$$N_{O2} = 3 N_T(50^\circ\text{C}) \ln\left(\frac{i_{O2}(50^\circ\text{C})}{i_s(50^\circ\text{C})}\right)$$

$$N_T(50^\circ\text{C}) = \frac{k}{q} (50^\circ\text{C} + 273) = 27,86 \text{ mV}$$

q

$$\boxed{N_{O2} = 61,50 \text{ mV}} \Rightarrow \boxed{N_{out} = 61,50 \text{ mV}}$$