

$$I_D = I_S (e^{V_D/V_T} - 1) \quad \text{I}$$

$$I_D = \frac{10 - V_D}{10} \text{ mA} \quad \text{II}$$

$$V_D = 10 - 10 I_D$$

$$V_D = 0.7 \text{ V}, I_D = 1 \text{ mA} \Rightarrow I_S = 1.7362 \text{ pA}$$

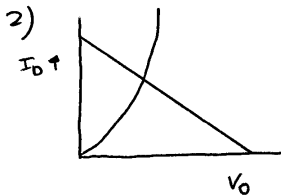
$$V_T = kT/q = 25.85 \text{ mV}$$

* $V_D = 0.7 \text{ V} \Rightarrow I_D = 1 \text{ mA} \Rightarrow V_D = 0 \Rightarrow I_D = 0$ erro (directão)

* $I_D = 1 \text{ mA} \Rightarrow V_D = 0.7 \text{ V} \Rightarrow I_D = 0.93 \text{ mA} \Rightarrow V_D = 0.5196 \text{ V}$

$I_D = 0.9480 \text{ mA} \Rightarrow V_D = 0.5201 \text{ V} \Rightarrow I_D = 0.9480 \text{ mA}$

$V_D = 0.5201 \text{ V}$



ponto de funcionamento

$$I_D = I_S (e^{V_D/3V_T} - 1) : V_D = 3V_T \ln(I_D/I_S) \quad \text{I}$$

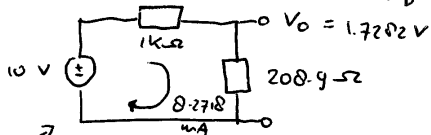
$$I_D = V_i - V_D \quad (\text{mA}) \quad \text{II}$$

$V_i = 10 \text{ V}, V_D = 3 \times 0.7 \text{ V} = 2.1 \text{ V} \Rightarrow I_D = 7.9 \text{ mA} \Rightarrow V_D = 1.7246 \text{ V}$

$\Rightarrow I_D = 0.2754 \text{ mA} \Rightarrow V_D = 1.7282 \text{ V} \Rightarrow I_D = 0.2718 \text{ mA} \Rightarrow V_D =$

$1.7282 \text{ V} \Rightarrow I_D = 0.2718 \text{ mA} \Rightarrow V_D = 1.7282 \text{ V}$

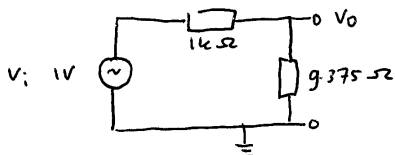
$$R_D = 1.7282 / 0.2718 \cdot 10^{-3} = 208.9 \Omega$$



modelo grande sinais

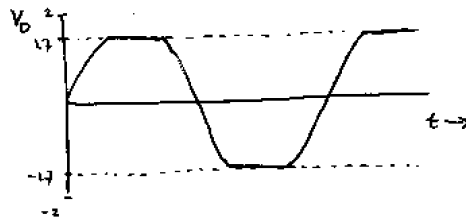
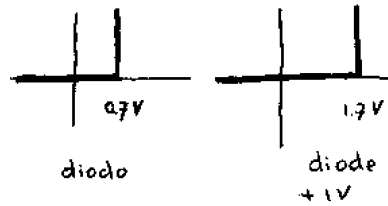
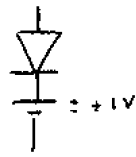
modelo pequenos sinais

$$r_D = 3V_T / I_D = 3 \times 25.85 \text{ mV} / 0.2718 \text{ mA} = 9.375 \Omega$$

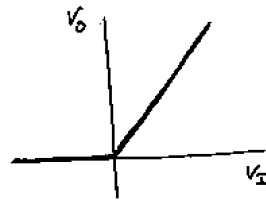
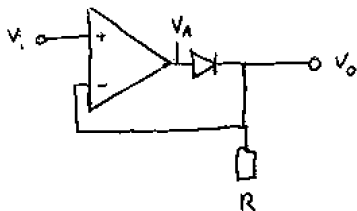


$$V_o = 9.29 \text{ mV}$$

3)



4)



Quando $V_i > 0$: $V_A > 0$, diodo fechado? $\Rightarrow R_{diodo} = \infty$
 $\Rightarrow A = \frac{R + R_{diodo}}{R} = \infty \Rightarrow V_A = \infty \Rightarrow V_A = +V_{cc}$
 diodo aberto!

diodo aberto? $\Rightarrow R_{diodo} = 0 \Rightarrow$

$$A = \frac{R + R_{diodo}}{R} = 1 \Rightarrow V_A = V_i \Rightarrow$$

$$V_o = V_A = V_i \quad (\text{diodo aberto}) \quad \boxed{V_o = V_i}$$

Quando $V_i < 0$: $V_A < 0$, diodo fechado $\Rightarrow A = \infty \Rightarrow$
 $V_A = -\infty$, \Rightarrow diodo fechado! ($V_A = -V_{cc}$)
 $V_o = 0$