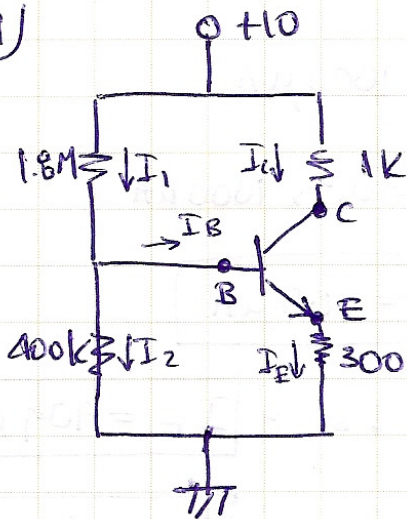


3

Fecha / Date:

a)



$$\beta = 400 = \frac{I_c}{I_B} \Rightarrow I_c = 400 I_B$$

$$I_B + I_c = I_E \Rightarrow I_E = 401 I_B$$

1pto

$$I_E = \frac{401}{400} I_c = 1.0025 I_c = I_E$$

$$\begin{aligned} * \quad 10 &= 1.8 \times 10^6 I_1 + 400 \times 10^3 I_2 \\ * \quad I_1 &= I_B + I_2 \end{aligned} \Rightarrow \begin{aligned} 10 &= 1.8 \times 10^6 I_1 + 0.4 \times 10^6 (I_1 - I_B) \\ &= 2.2 \times 10^6 I_1 - 4 \times 10^5 \frac{I_c}{400} \end{aligned}$$

$$\Rightarrow 10 = 2.2 \times 10^6 I_1 - 10^3 I_c$$

$$* \quad 400 \times 10^3 I_2 = V_{BE} + 300 I_E$$

$$\Rightarrow 4 \times 10^5 \left( I_1 - \frac{I_c}{400} \right) = 0.7 + 300 \times 1.0025 I_c$$

$$4 \times 10^5 I_1 - 10^3 I_c = 0.7 + 300.75 I_c$$

$$4 \times 10^5 I_1 - 1300.75 I_c = 0.7$$

$$\Rightarrow 10 = 2.2 \times 10^6 I_1 - 10^3 I_c$$

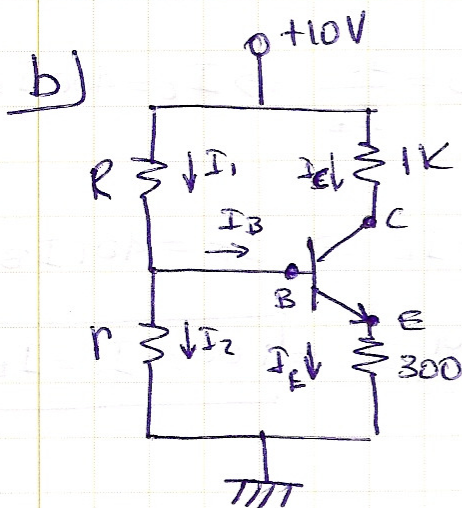
$$(0.7 = 0.4 \times 10^6 I_1 - 1300.75 I_c) \times -\frac{2.2}{0.4} \quad 1pto$$

$$\Rightarrow 6.15 = 6154.125 I_c \Rightarrow I_c = 999 \mu A //$$

$$* \quad \cancel{10 = 10^3 I_c + V_{CE} + 300 I_E} \quad 10 = 10^3 I_c + V_{CE} + 300 I_E$$

$$\Rightarrow V_{CE} = 10 - 999 \times 10^{-3} - 300 \times 1.0025 \times 999 \times 10^{-6} \Rightarrow V_{CE} = 8.7V$$





$$* I_{ced} = 1000 \mu A$$

$$\Rightarrow I_c = 0.9 \times 1000 \mu A$$

$$I_c = 900 \mu A$$

0.5 pts

$$I_E = 101 I_B \rightarrow I_E = 909 \mu A$$

$$I_c = 100 I_B \rightarrow I_B = 9 \mu A$$

$$* 10^3 I_E + V_{CE} + 300 I_E = 10$$

$$10^3 \times 900 \times 10^{-6} + V_{CE} + 300 \times 909 \times 10^{-6} = 10$$

$$0.900 + V_{CE} + 0.2727 = 10 \Rightarrow V_{CE} = 8.8273V$$

$$* V_{CE} = V_{CB} + V_{BE} \Rightarrow V_{CB} = 8.827 - 0.7 \Rightarrow V_{CB} = 8.127V$$

$$* R I_1 = 10^3 I_c + V_{CB} = 0.9 + 8.127$$

$$R I_1 = 9.027$$

$$* r I_2 = V_{BE} + 300 \times I_E$$

$$r I_2 = 0.7 + 0.2727 \Rightarrow r I_2 = 0.9727 = R I_2 \quad (\text{ver abajo})$$

$$* I_1 = I_B + I_2 \Rightarrow$$

Asumo  $R = r$

$$R I_1 = R I_B + R I_2$$

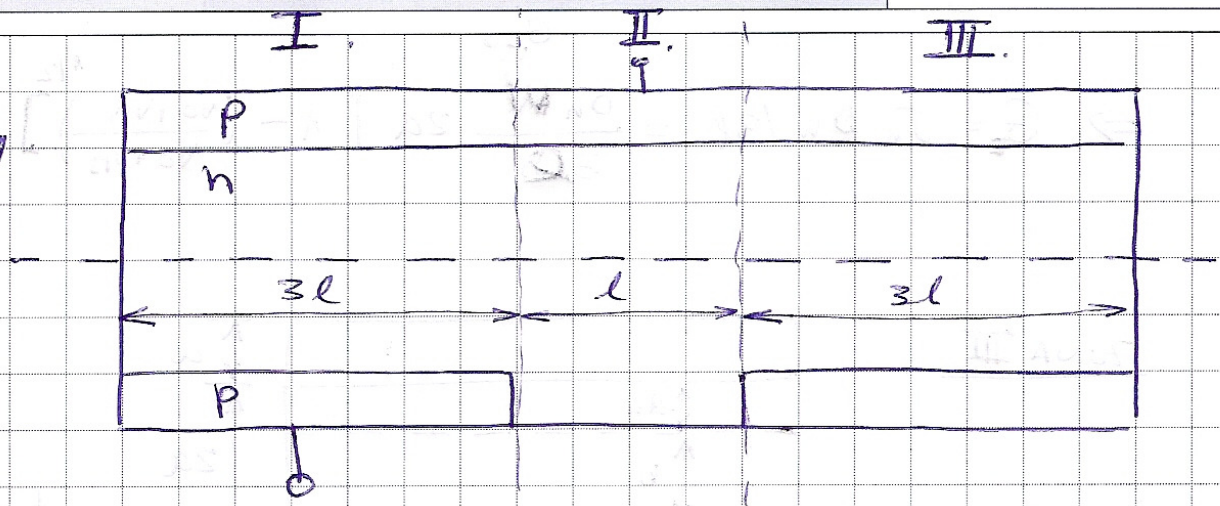
$$9.027 = R \times 9 \times 10^{-6} + 0.9727$$

$$\frac{8.055 \times 10^6}{9} = R = 0.895 M$$

1.5 pts



(4)



a) Los pinch-off van a ser diferentes porque las zonas de agotamiento son diferentes:

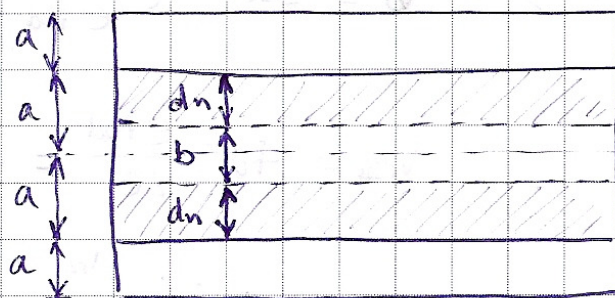
I  $\rightarrow$  simétrico

1pt

II  $\rightarrow$  asimétrico solo zona de agotamiento en la parte superior

III  $\rightarrow$  asimétrico. En la parte superior zona de agotamiento producida por  $V_g$  + potencial de contacto. En la parte inferior solo potencial de contacto.

b) ZONA I

1pt

$$V_j = V_0 + V_g$$

$$d_n = \left( \frac{2\epsilon V_j}{e N_d} \right)^{1/2} = -\frac{b}{2} + a$$

Pinchoff:

$$d_n = a = \left( \frac{2\epsilon (V_0 + V_{P_i})}{e N_d} \right)^{1/2} \Rightarrow \frac{a^2 e N_d}{2\epsilon} - V_0 = V_{P_i}$$

$$\Rightarrow \frac{e N_d}{2\epsilon} = \frac{1}{a^2} (V_{P_i} + V_0)$$

Notas / Notes:

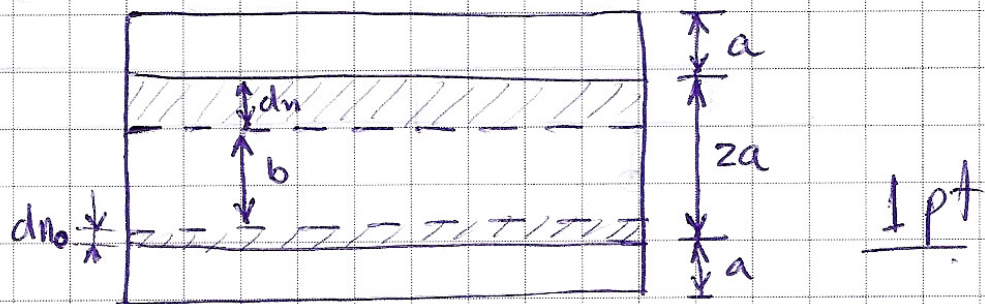
$$\Rightarrow d_n = \left[ a^2 \frac{V_0 + V_{P_i}}{V_{P_i} + V_0} \right]^{1/2} = a - \frac{b}{2}$$

$$\text{so } \frac{b}{2} = a \left[ 1 - \left( \frac{V_0 + V_{P_i}}{V_{P_i} + V_0} \right)^{1/2} \right]$$



$$\Rightarrow G_I = \sigma_n bw / 3l = \frac{\sigma_n W}{3l} 2a \left[ 1 - \left( \frac{V_0 + V_{gs}}{V_0 + V_{ps}} \right)^{1/2} \right]$$

ZONA III



$$b = 2a - d_n - d_{n0}$$

$$d_n = \left( \frac{2\epsilon V_i}{e N_d} \right)^{1/2}$$

$$d_{n0} = \left( \frac{2\epsilon V_0}{e N_d} \right)^{1/2}$$

Pinch off:  $b = 0 = 2a - \left[ \frac{2\epsilon (V_0 + V_{ps})}{e N_d} \right]^{1/2} - \left[ \frac{2\epsilon V_0}{e N_d} \right]^{1/2}$

Despreciar  $V_0 \Rightarrow 0 = 2a - \left[ \frac{2\epsilon V_{ps}}{e N_d} \right]^{1/2}$

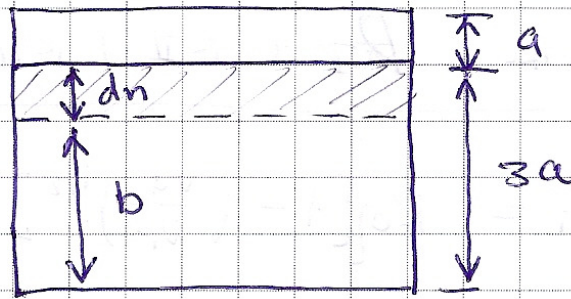
$$V_{ps} = 4a^2 \frac{e N_d}{2\epsilon} = 4 V_{PI}$$

$$\begin{aligned} \therefore b &= 2a - \left[ \frac{2\epsilon V_G}{e N_d} \right]^{1/2} = 2a - \left[ 4a^2 \frac{V_G}{V_{PI}} \right]^{1/2} \\ &= 2a \left[ 1 - \left( \frac{V_G}{V_{PI}} \right)^{1/2} \right] \end{aligned}$$

$$\therefore G_{II} = \frac{\sigma_n bw}{3l} = \frac{\sigma_n W}{3l} 2a \left[ 1 - \left( \frac{V_G}{V_{PI}} \right)^{1/2} \right]$$



ZONA II



$$b = 3a - d_n ; \quad d_n = \left( \frac{2 \epsilon V_j}{e N_d} \right)^{1/2}$$

Pinchoff : 
$$0 = 3a - \left[ \frac{2 \epsilon (V_0 + V_{P_{II}})}{e N_d} \right]^{1/2}$$

$$\begin{aligned} \frac{2 \epsilon}{e N_d} &= \frac{g a^2}{V_0 + V_{P_{II}}} \xrightarrow{\text{Despejando } V_0} V_{P_{II}} = g a^2 \frac{e N_d}{2 \epsilon} \\ &= g V_{P_I} \end{aligned}$$

$$b = 3a - 3a \left( \frac{V_0 + V_G}{V_0 + V_{P_{II}}} \right)^{1/2}$$

$$b = 3a \left[ 1 - \left( \frac{V_0 + V_G}{V_0 + V_{P_{II}}} \right)^{1/2} \right]$$

$$G_{II} = \frac{\sigma_n b w}{e} = \underbrace{\frac{\sigma_n w}{e}}_{G_{II0} = g/2 G_{I0}} 3a \left[ 1 - \left( \frac{V_G}{V_{P_{II}}} \right)^{1/2} \right]$$

$$G_I = G_0 \left[ 1 - \left( \frac{V_G}{V_P} \right)^{1/2} \right]$$

$$G_{II} = \frac{g}{2} G_0 \left[ 1 - \left( \frac{V_G}{g V_P} \right)^{1/2} \right]$$

$$G_{III} = G_0 \left[ 1 - \left( \frac{V_G}{g V_P} \right)^{1/2} \right]$$



$$R_{TOTAL} = R_I + R_{II} + R_{III}$$

$$R_{TOT.} = R_0 \left\{ \left[ 1 - \left( \frac{V_g}{V_p} \right)^{1/2} \right]^{-1} + \frac{2}{q} \left[ 1 - \left( \frac{V_g}{V_p} \right)^{1/2} \right]^{-1} + \left[ 1 - \left( \frac{V_g}{4V_p} \right)^{1/2} \right]^{-1} \right\}$$