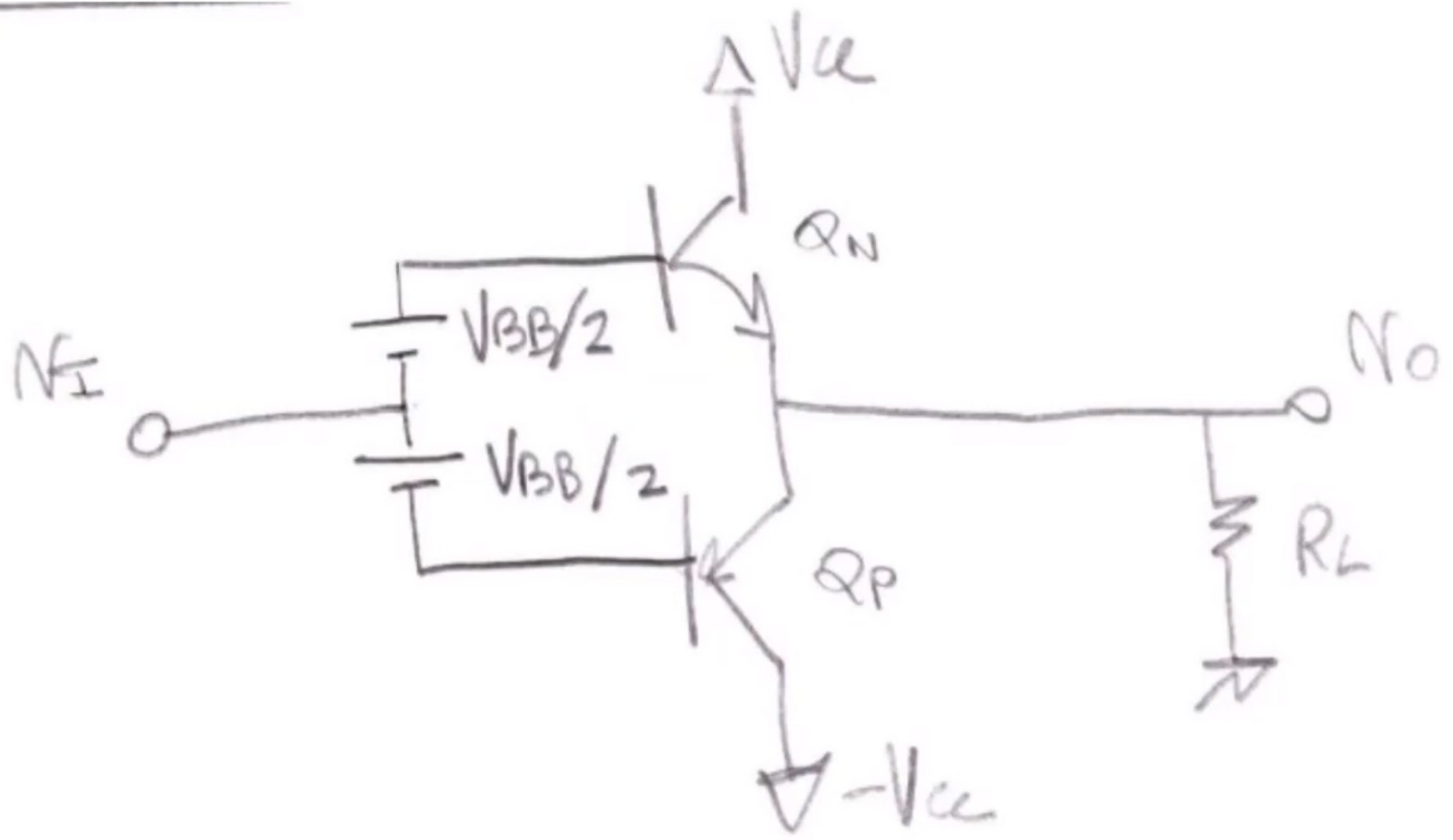
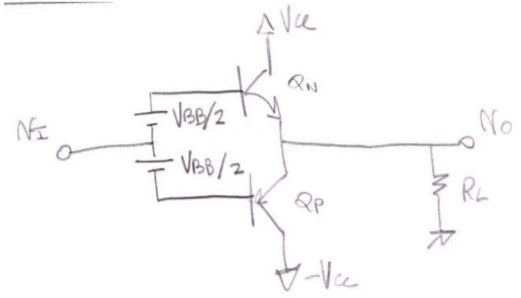
Clase AB



Clase AB



Si $V_I = 0 \Rightarrow i_n = i_p = I_Q = I_S e^{\frac{V_{BB}}{2V_T}} \Rightarrow$ (I) $V_{BB} = 2V_T \ln\left(\frac{I_Q}{I_S}\right)$

En cualquier caso:

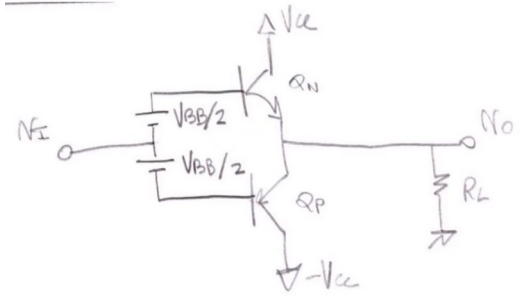
$$V_{BB} = V_{BEN} + V_{EBP} = V_T \ln\left(\frac{i_n}{I_S}\right) + V_T \ln\left(\frac{i_p}{I_S}\right)$$

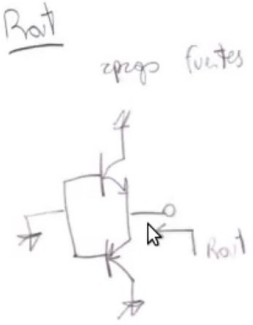
$$= V_T \ln\left(\frac{i_n \cdot i_p}{I_S^2}\right) = 2V_T \ln\left(\frac{\sqrt{i_n i_p}}{I_S}\right) \quad \text{(II)}$$

(I) y (II) $\Rightarrow I_Q^2 = i_n \cdot i_p$

Si $i_n \uparrow \Rightarrow i_p \downarrow$ en igual proporción.

Clase AB



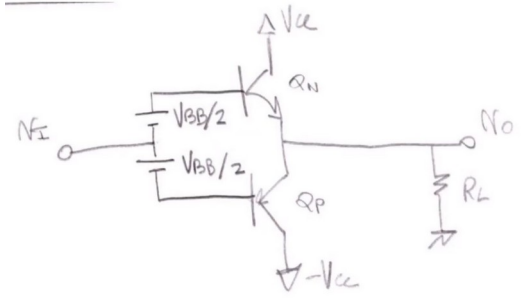


$$I_Q^2 = i_N \cdot i_P$$

$$R_{out} = r_N \,//\, r_P = \frac{V_T}{i_N + i_P}$$

$$r_N = \frac{V_T}{g_{mn}} = \frac{V_T}{i_N} \qquad r_P = \frac{V_T}{g_{mp}} = \frac{V_T}{i_P}$$

Clase AB



$$I_Q^2 = i_N \cdot i_P$$

$$R_{out} = r_N \parallel r_P = \frac{V_T}{i_N + i_P}$$

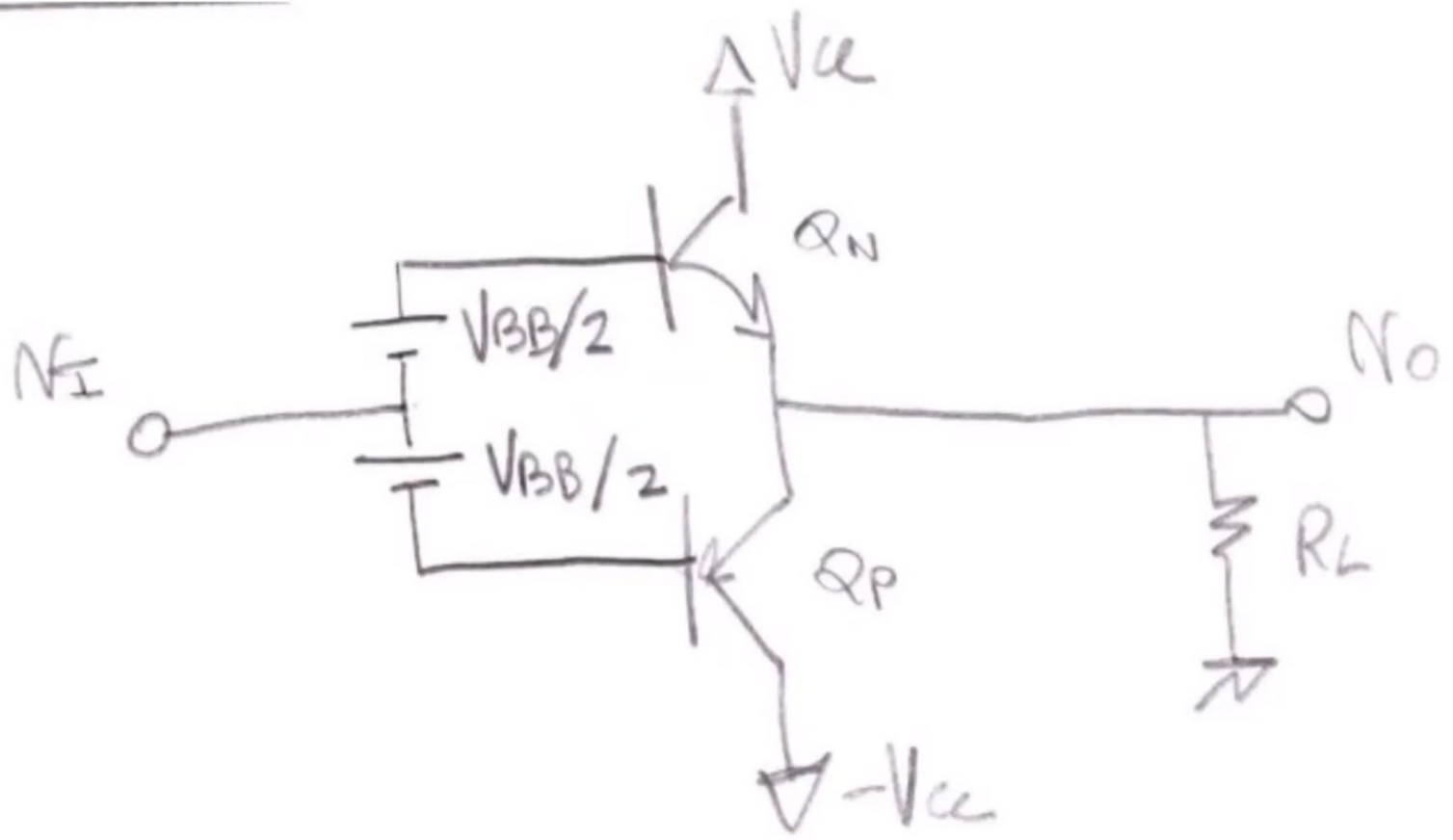
$$\frac{1}{g_{mn}} = \frac{V_T}{i_N} \qquad \frac{1}{g_{mp}} = \frac{V_T}{i_P}$$

$$R_{out} = \frac{V_T}{i_n + \frac{I_Q^2}{i_n}} = \frac{V_T i_n}{i_n^2 + I_Q^2}$$

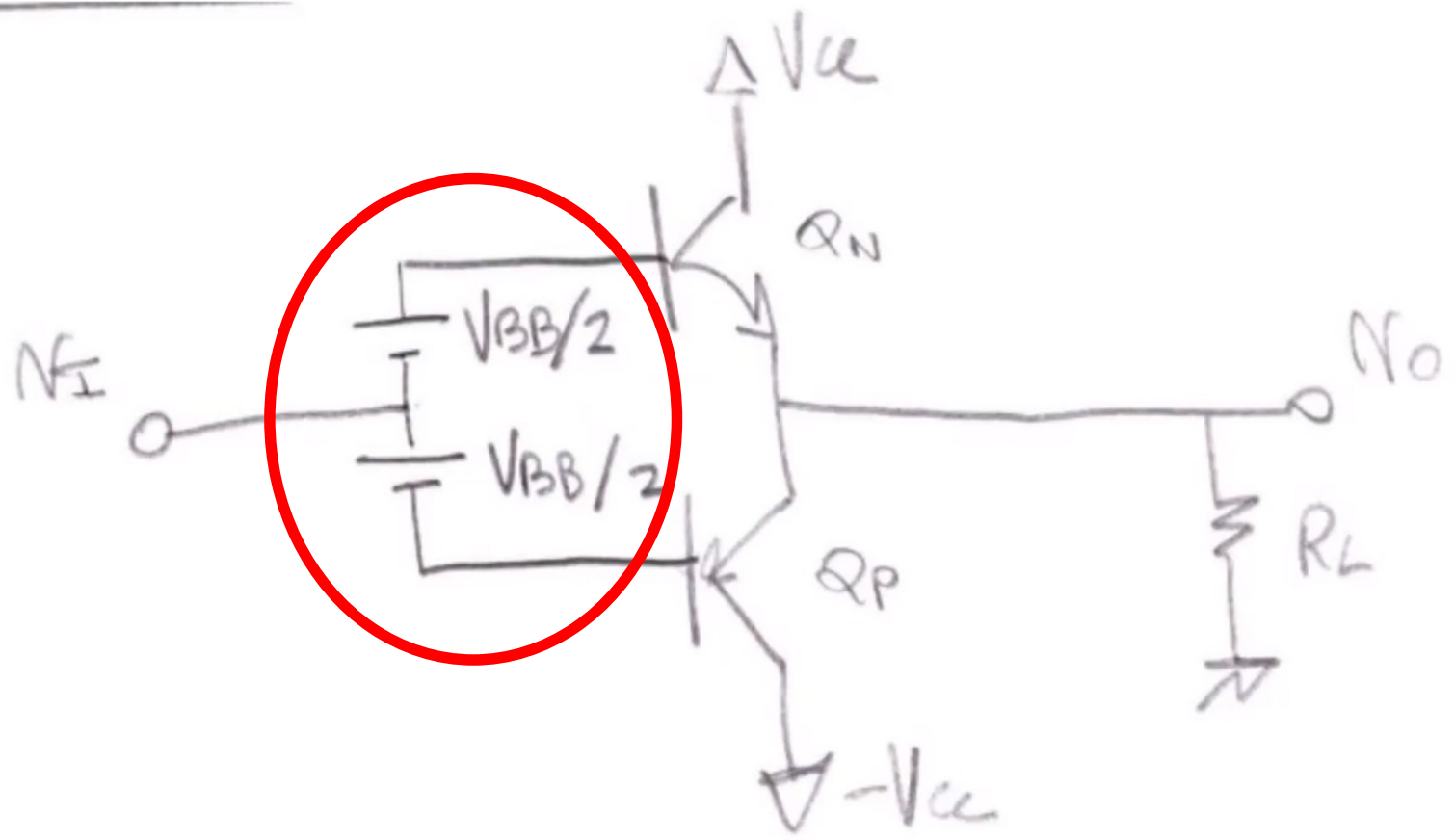
$$\frac{\partial R_{out}}{\partial i_n} = \frac{V_T (i_n^2 + I_Q^2) - V_T i_n 2 i_n}{(i_n^2 + I_Q^2)^2} = V_T \frac{(I_Q^2 - i_n^2)}{(i_n^2 + I_Q^2)^2}$$

$$\frac{\partial R_{out}}{\partial i_n} = 0 \quad \text{cuando} \quad i_n = I_Q$$

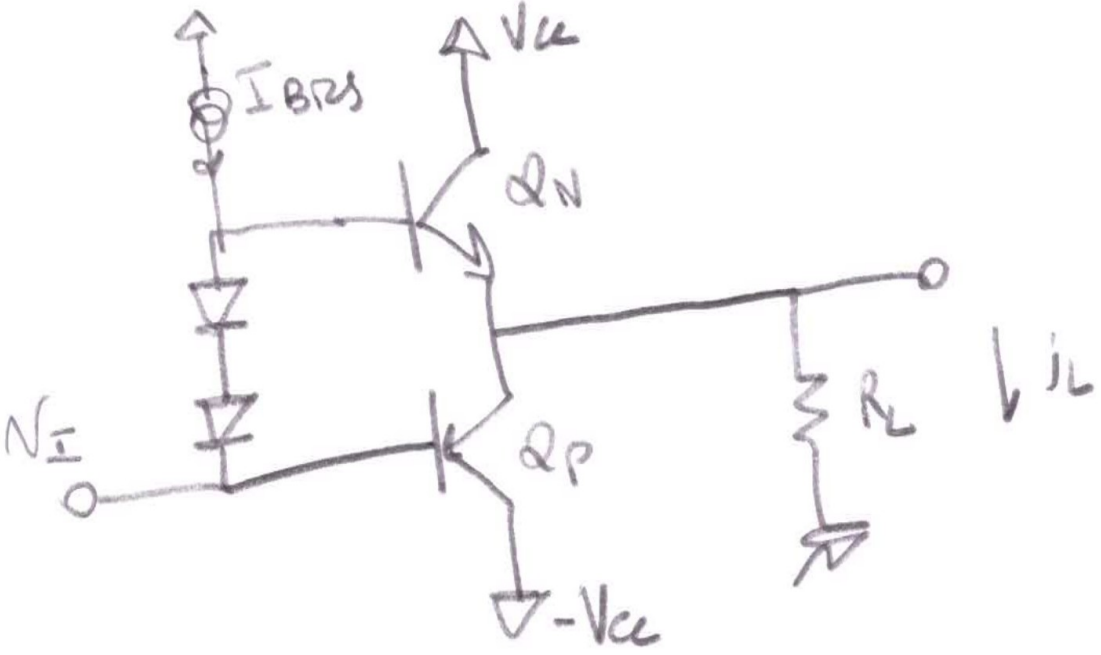
Clase AB



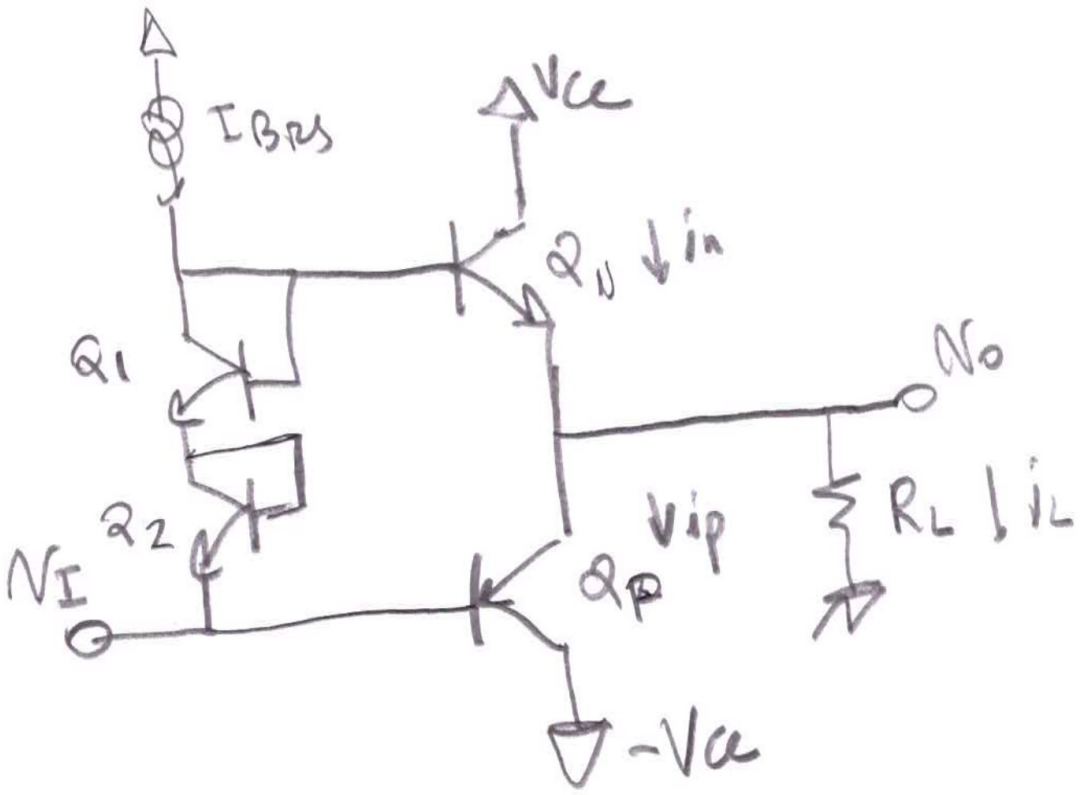
Clase AB



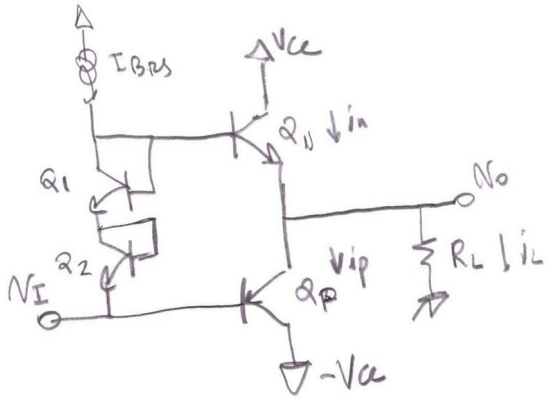
Clase AB



Clase AB

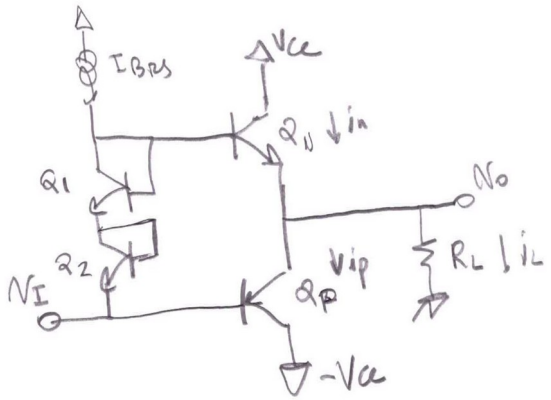


Clase AB



I_{bias} vs I_Q

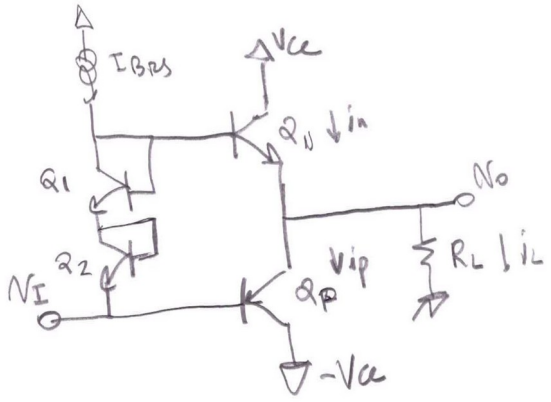
Clase AB



I_{bias} vs I_Q

$$2V_{BE\,1,2} = 2V_{BE\,N,P}$$

Clase AB



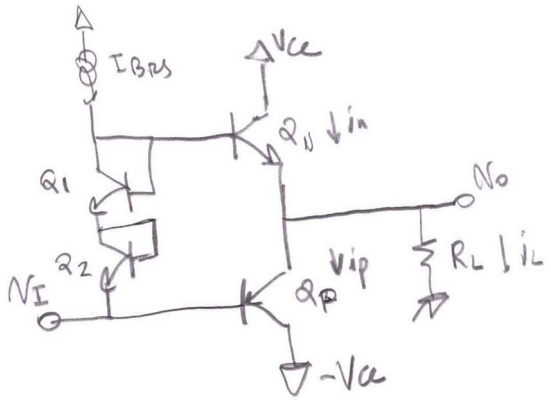
I_{bias} vs I_Q

$$2V_{BE\,1,2} = 2V_{BE\,N,P}$$

$$\Rightarrow V_E = 0$$

$$2V_T Ln\left(\frac{I_{BIAS}}{I_{S\,1,2}}\right) = 2V_T Ln\left(\frac{I_Q}{I_{SN,P}}\right)$$

Clase AB



I_{bias} vs I_Q

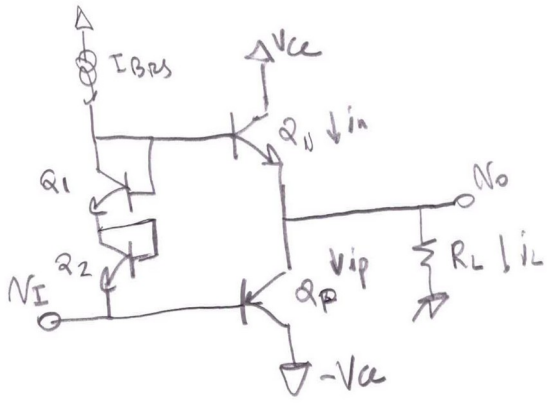
$$2V_{BE\,1,2} = 2V_{BE\,N,P}$$

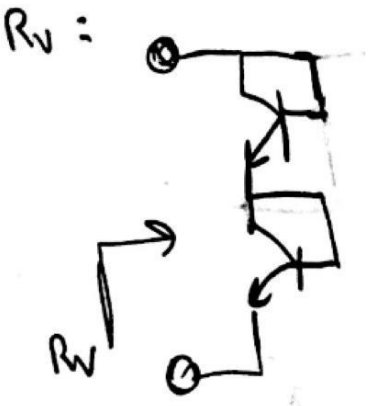
$$\Rightarrow V_E = 0$$

$$2V_T Ln\left(\frac{I_{BIAS}}{I_{S\,1,2}}\right) = 2V_T Ln\left(\frac{I_Q}{I_{SN,P}}\right)$$

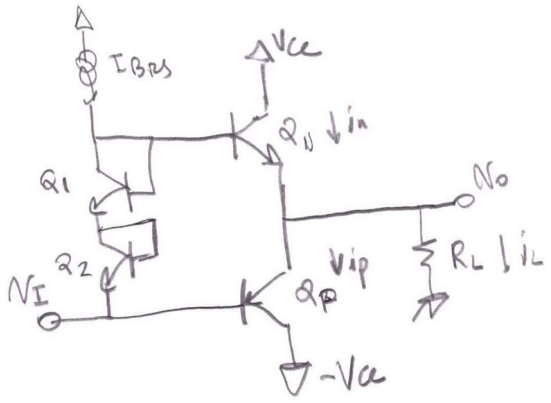
$$\Rightarrow I_Q = \overbrace{\frac{I_{SN,P}}{I_{S\,1,2}}}^{n} \cdot I_{BIAS}$$

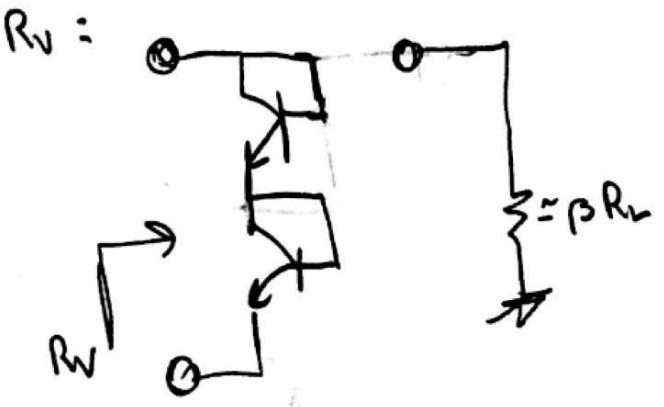
Clase AB



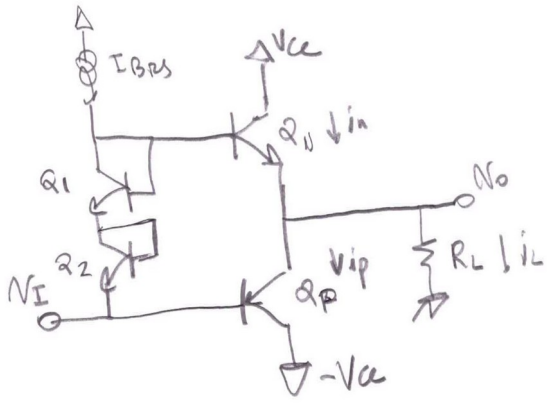


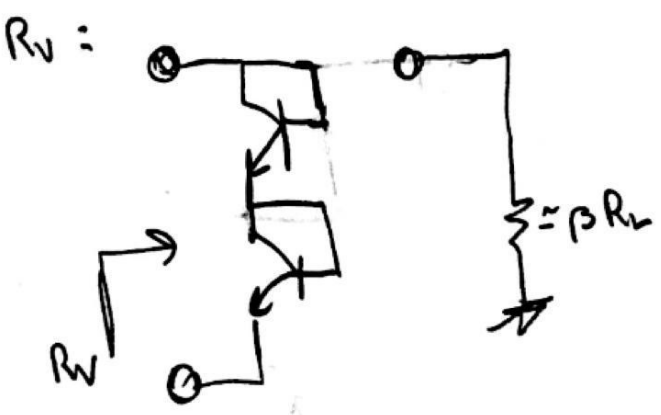
Clase AB





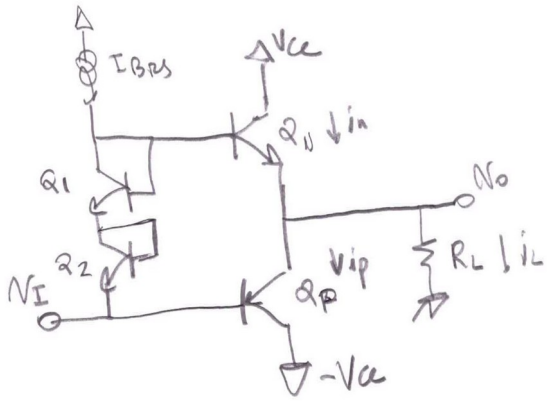
Clase AB





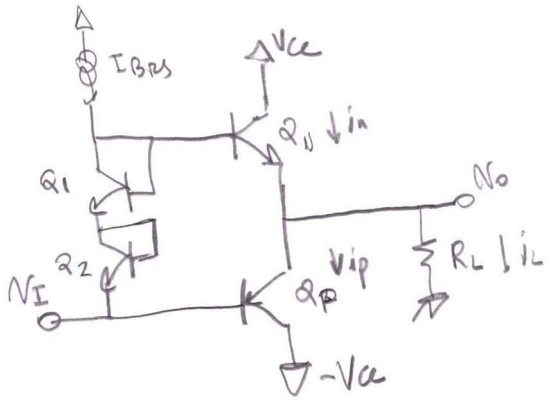
$$R_v = \frac{2}{g_m}$$

Clase AB



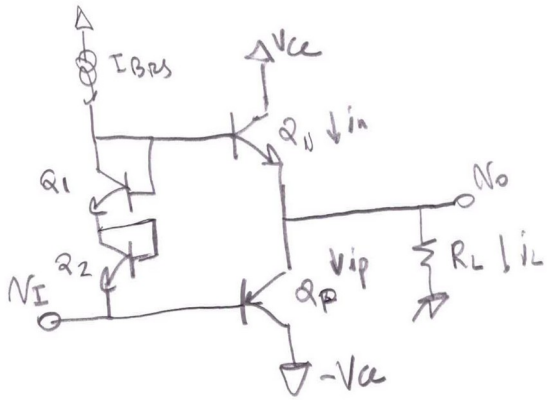
$$I_{BIAS} = I_{CQ1} \cdot \frac{i_n}{\beta_n}$$

Clase AB



$$I_{BIAS} = I_{CQ1} * \frac{V_o/R_L}{\beta n}$$

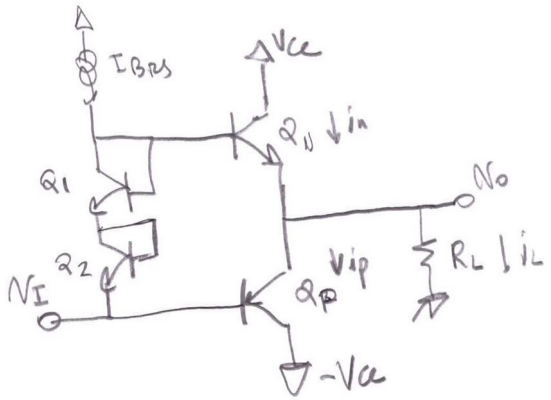
Clase AB



fijo

$$I_{BIAS} = I_{CQ1} * \frac{V_o/R_L}{\beta_n}$$

Clase AB

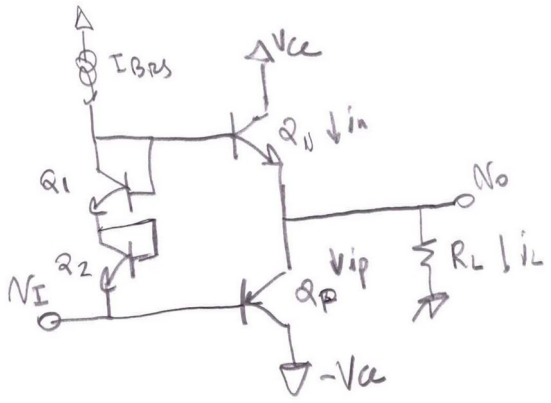


fijo

depende de Vo(t)

$$I_{BIAS} = I_{CQ1} + \frac{V_o / R_L}{\beta_n}$$

Clase AB



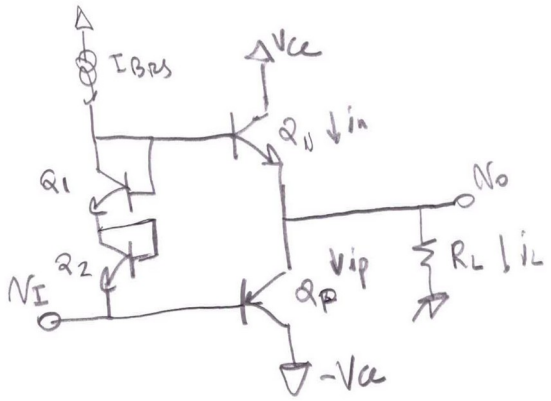
Se queda con el resto

fijo

depende de Vo(t)

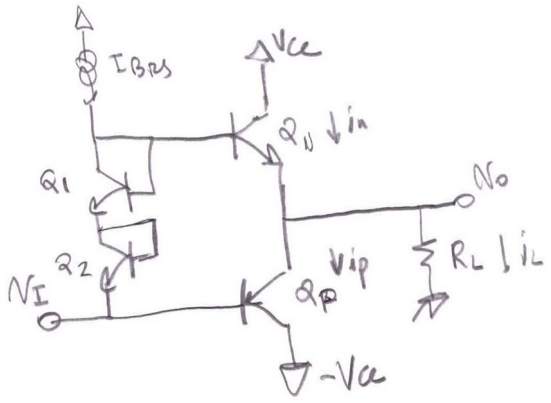
$$I_{BIAS} = I_{CQ1} + \frac{V_o/R_L}{\beta_n}$$

Clase AB



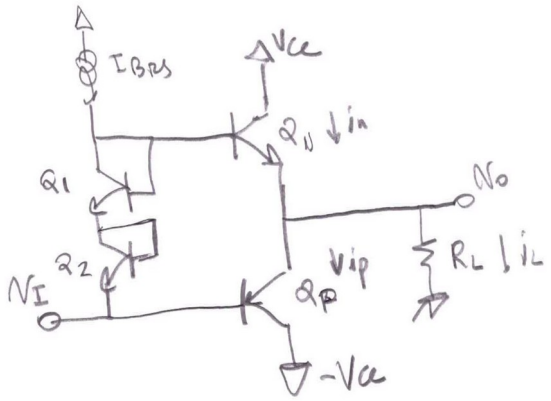
$$I_{CQ_1}(t) = I_{BIAS} - \frac{V_o/R_L}{\beta_n}$$

Clase AB



$$I_{cQ_1}(t) = \frac{I_Q}{n} - \frac{V_o/R_L}{\beta_n}$$

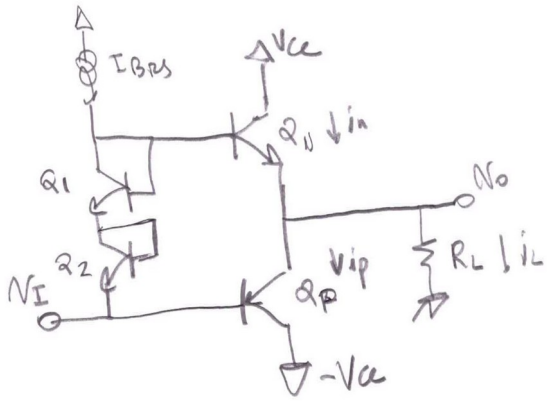
Clase AB



$$I_{CQ_1}(t) = \frac{I_Q}{n} - \frac{V_o/R_L}{\beta_n}$$

$$\hat{V}_o \gg I_Q$$

Clase AB

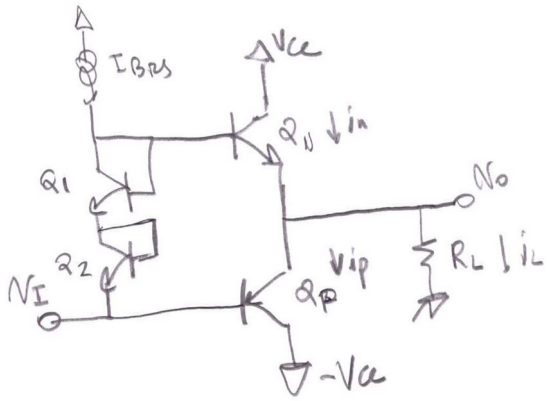


$$I_{cQ_1}(t) = \frac{I_Q}{n} - \frac{V_o/R_L}{\beta_n}$$

$\hat{V}_o / R_L \gg I_Q$

$\beta_n \simeq 50$

Clase AB



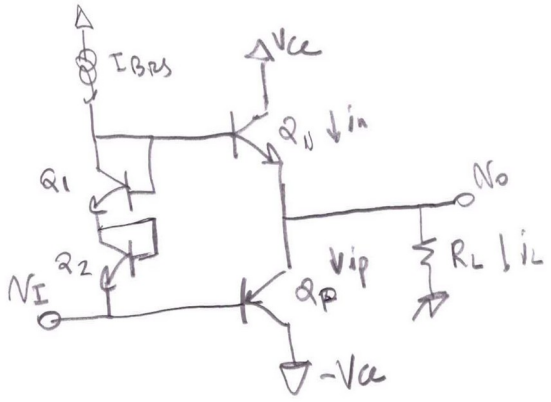
No puedo hacer n muy grande

$$I_{cQ_1}(t) = \frac{I_Q}{n} - \frac{V_o/R_L}{\beta_n}$$

$$\frac{\hat{V}_o}{R_L} \gg I_Q$$

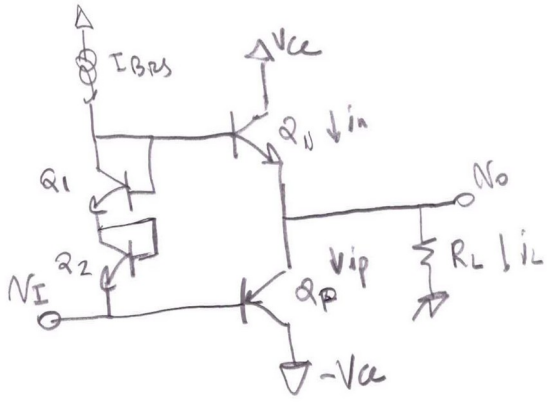
$\beta_n \simeq 50$

Clase AB

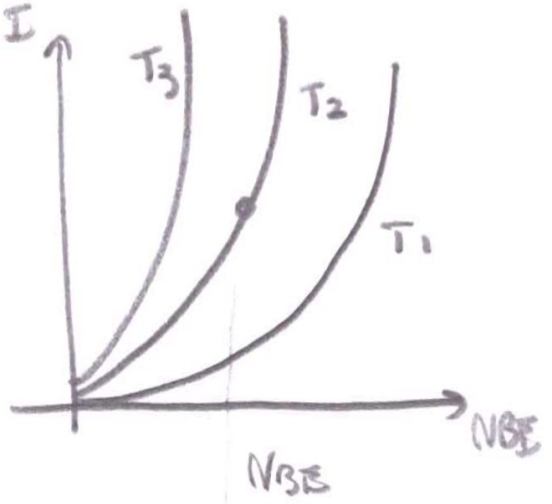


Corrida térmica:

Clase AB

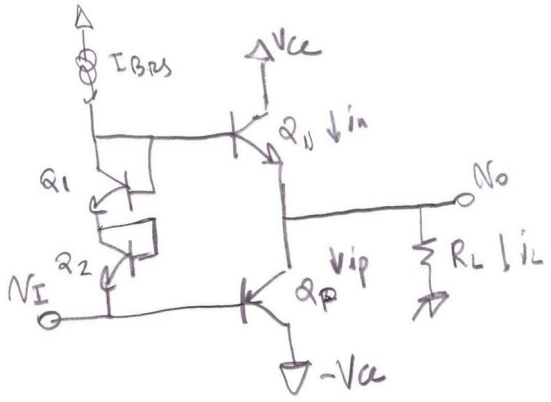


Corrida térmica:

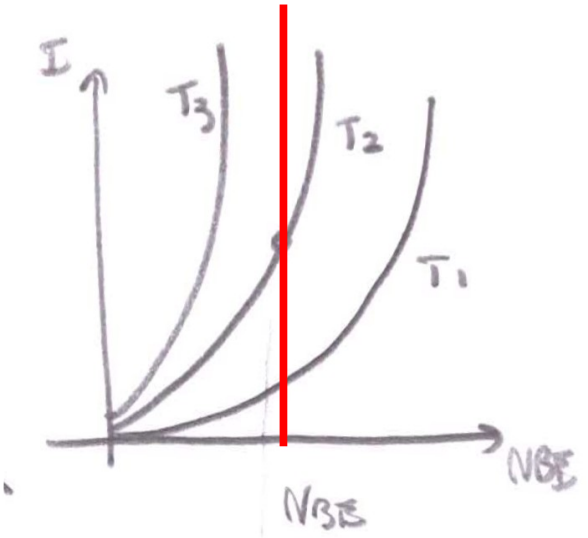


$T_3 > T_2 > T_1$

Clase AB

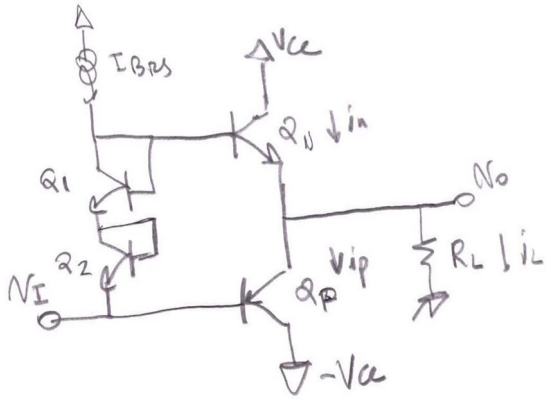


Corrida térmica:



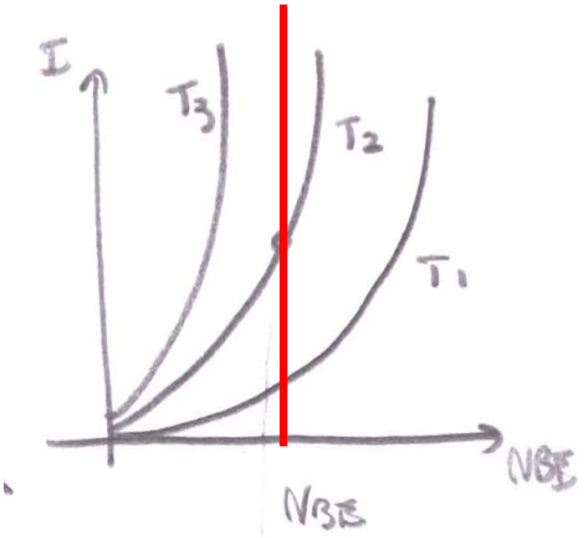
$T_3 > T_2 > T_1$

Clase AB



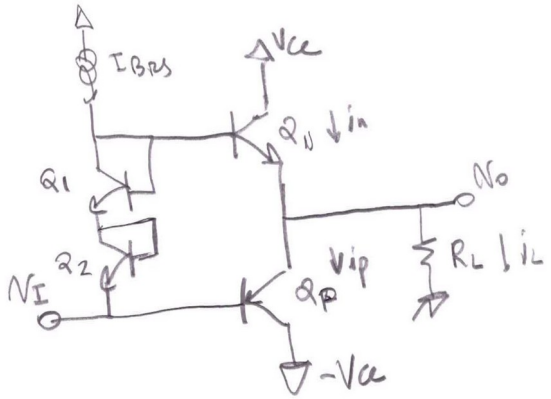
T ↑

Corrida térmica:



$T_3 > T_2 > T_1$

Clase AB



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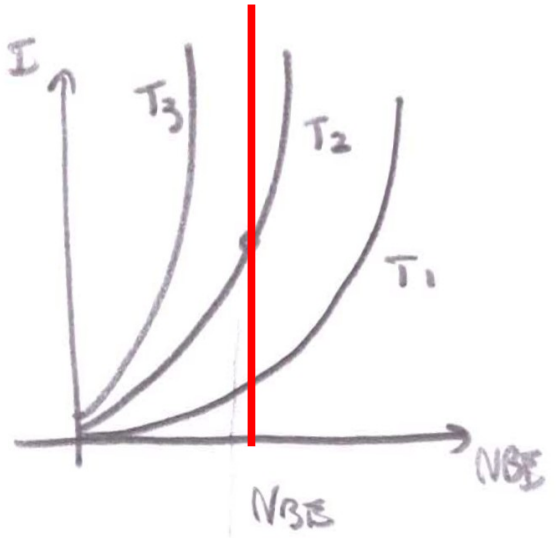
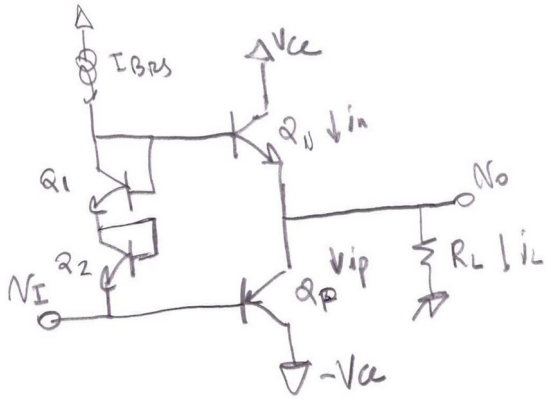


$T_3 > T_2 > T_1$

$T \uparrow \rightarrow I_Q \uparrow$

Clase AB



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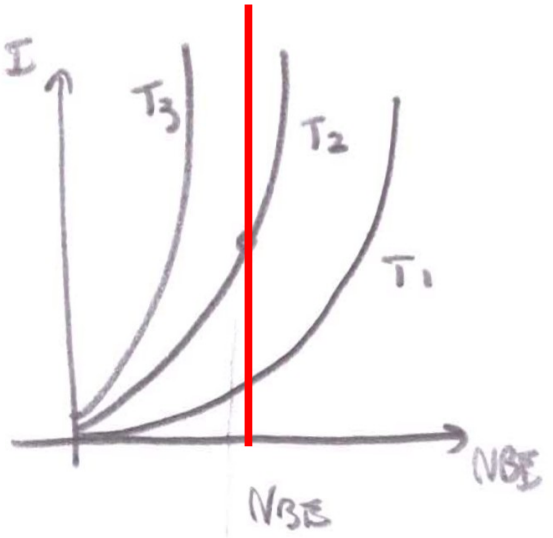
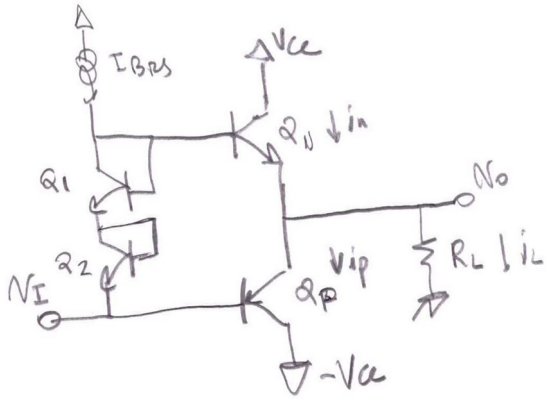


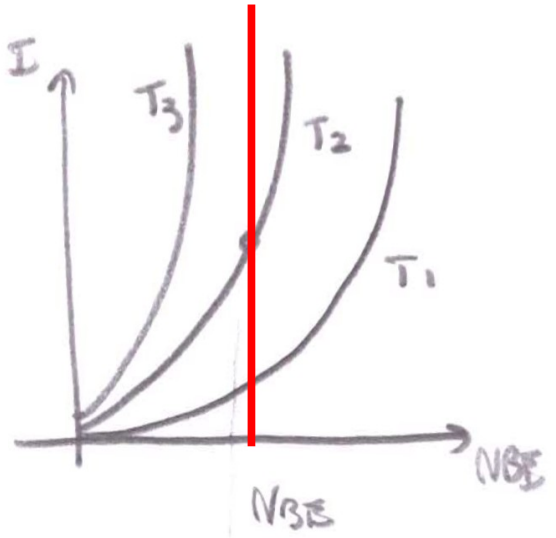
$T_3 > T_2 > T_1$

$T \uparrow \rightarrow I_Q \uparrow \rightarrow P \uparrow$

Clase AB



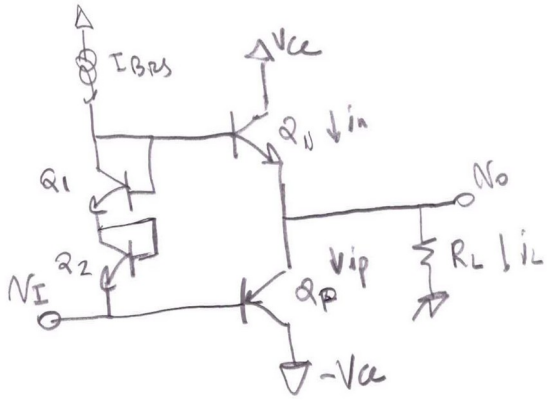
Corrida térmica:



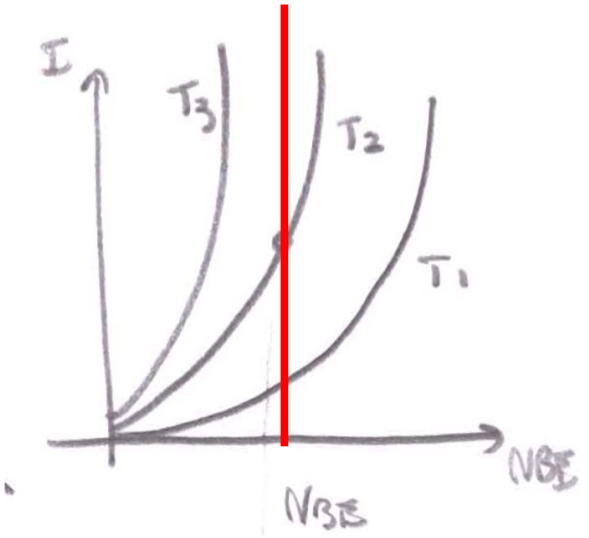
$T_3 > T_2 > T_1$

$$T \uparrow \rightarrow I_Q \uparrow \rightarrow P \uparrow \rightarrow T \uparrow$$

Clase AB



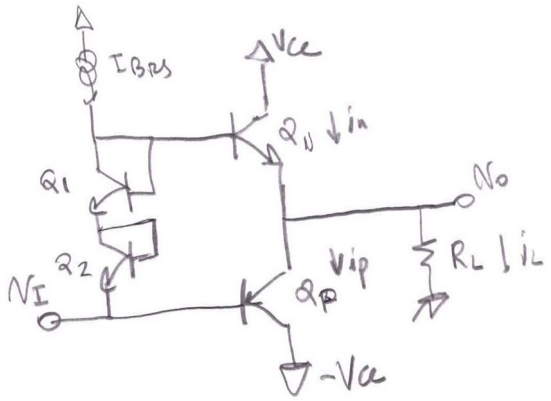
Corrida térmica:

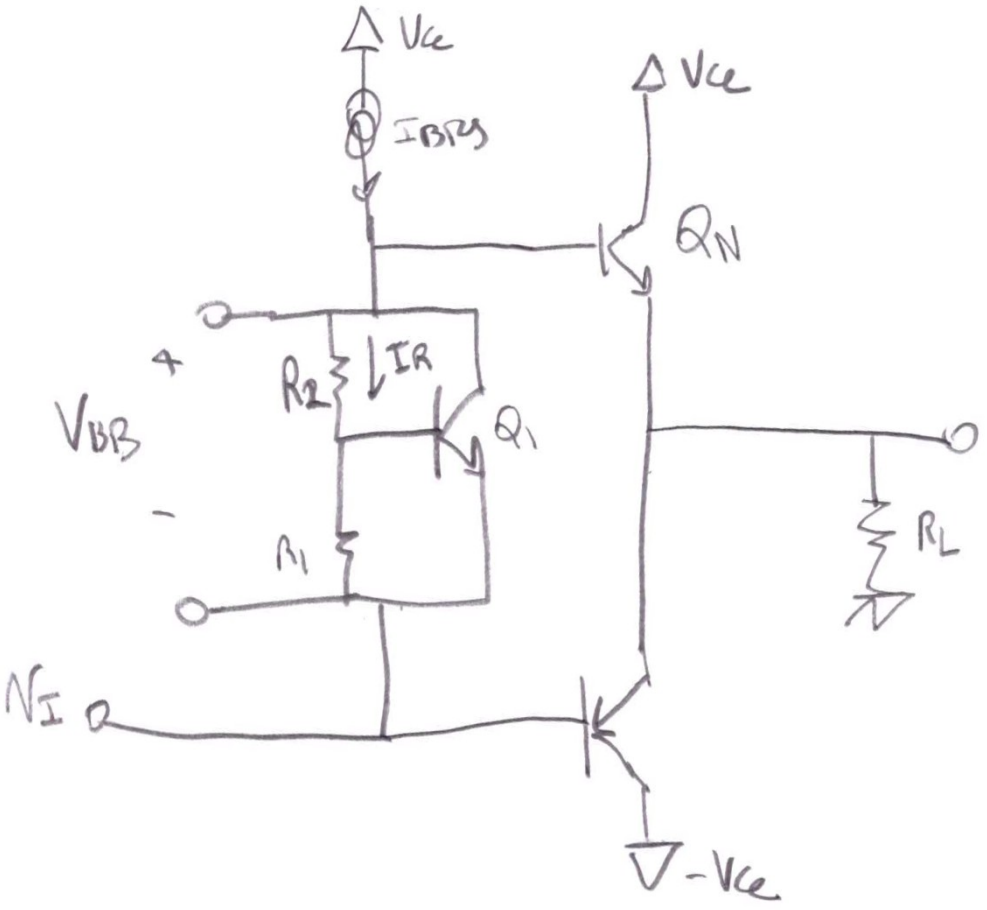


$T_3 > T_2 > T_1$

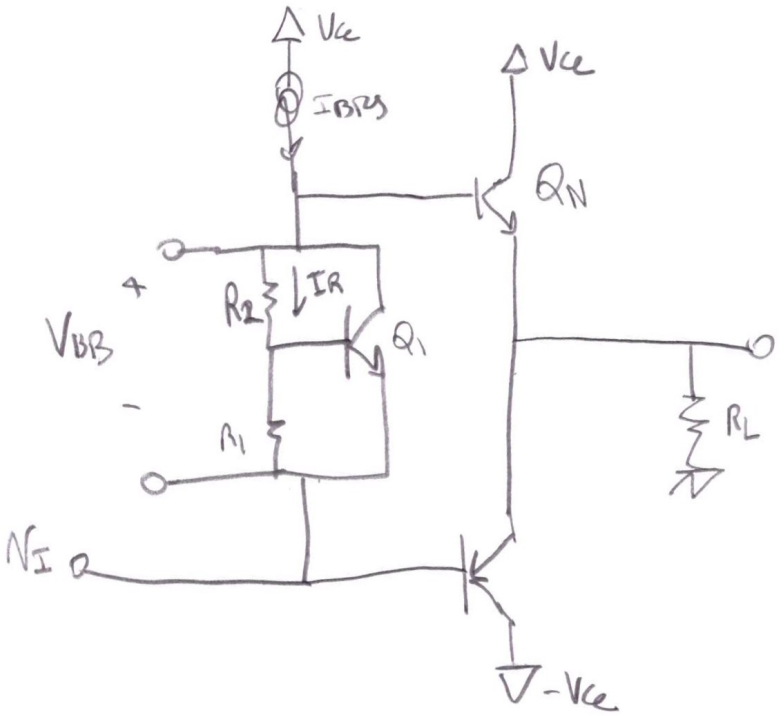
Solución: contacto térmico

Clase AB

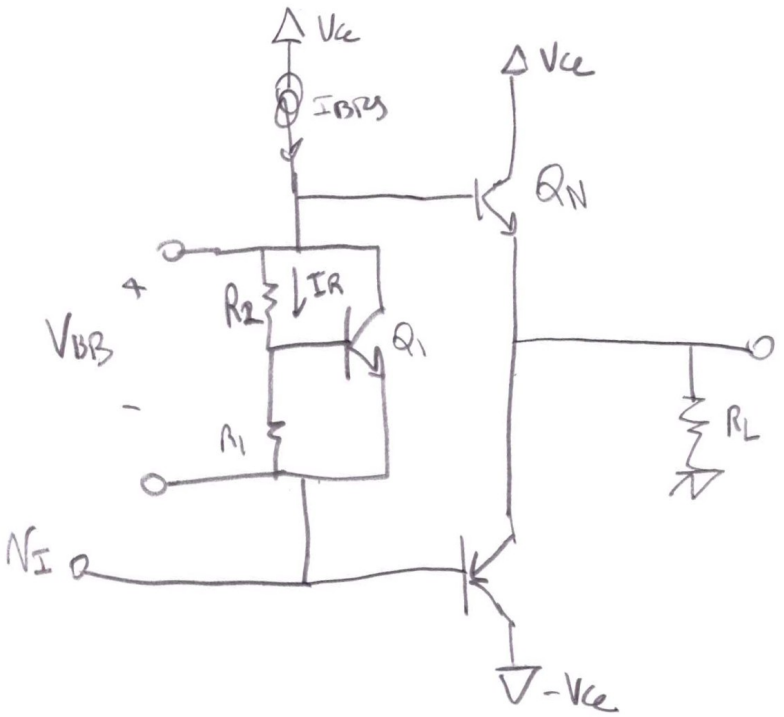

IBIAS
Vcc
Q1
Q2
VI
Vo
RL
iL
-Vcc


Vcc
IBIAS
QN
R2
IR
Q1
VBB
R1
RL
VI
-Vcc

Clase AB

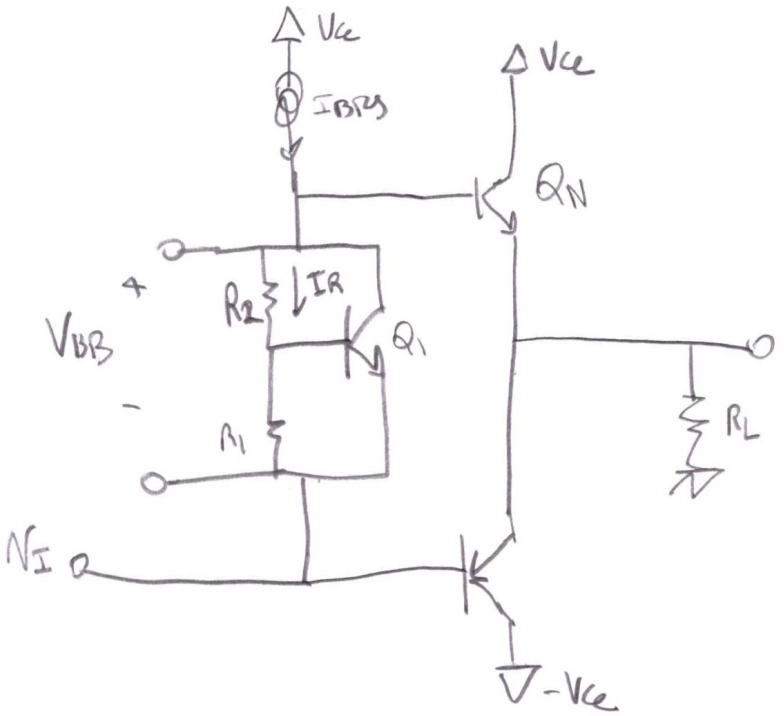


Clase AB



$$I_R = \frac{V_{BE1}}{R_1}$$

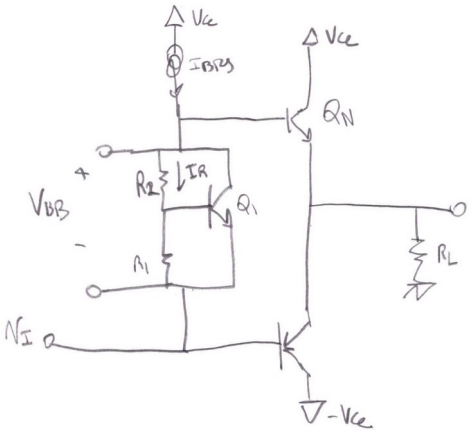
Clase AB

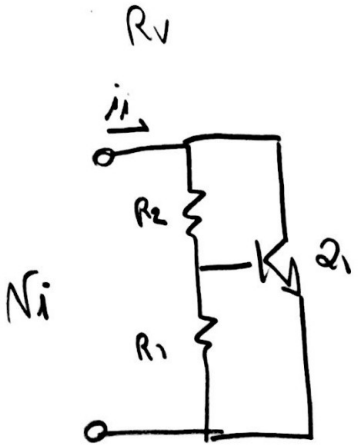


$$I_R = \frac{V_{BE1}}{R_1}$$

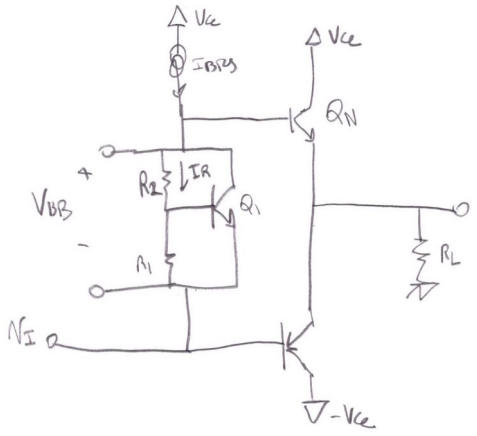
$$V_{BB} = I_R (R_1 + R_2) = V_{BE1} \left(1 + \frac{R_2}{R_1} \right)$$

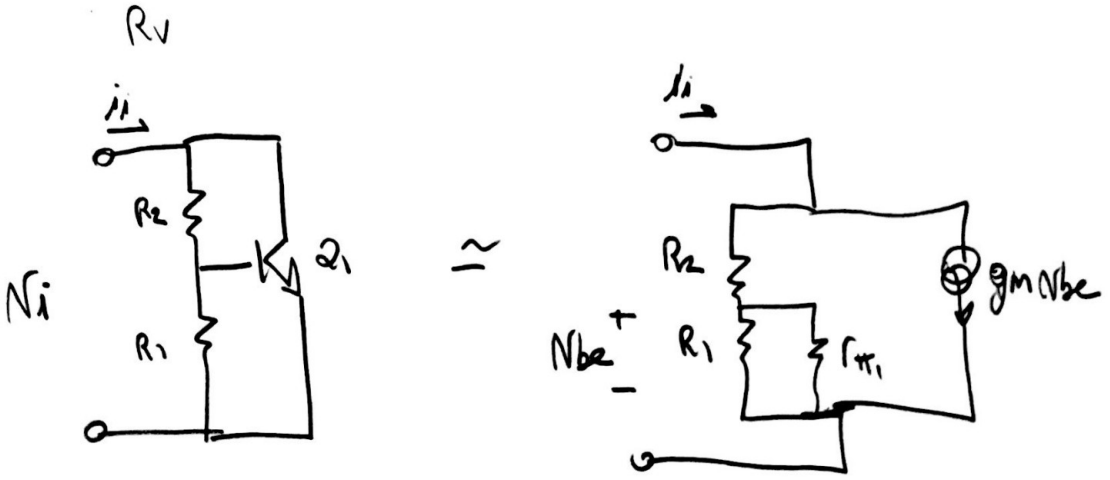
Clase AB



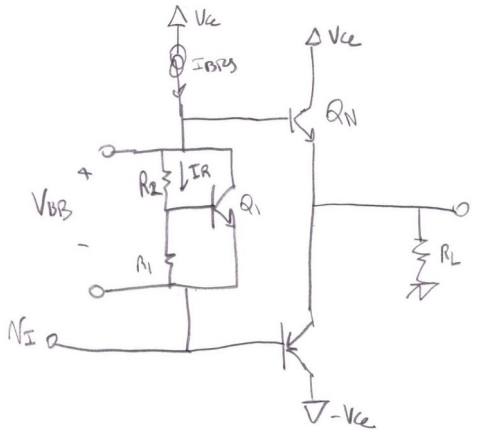


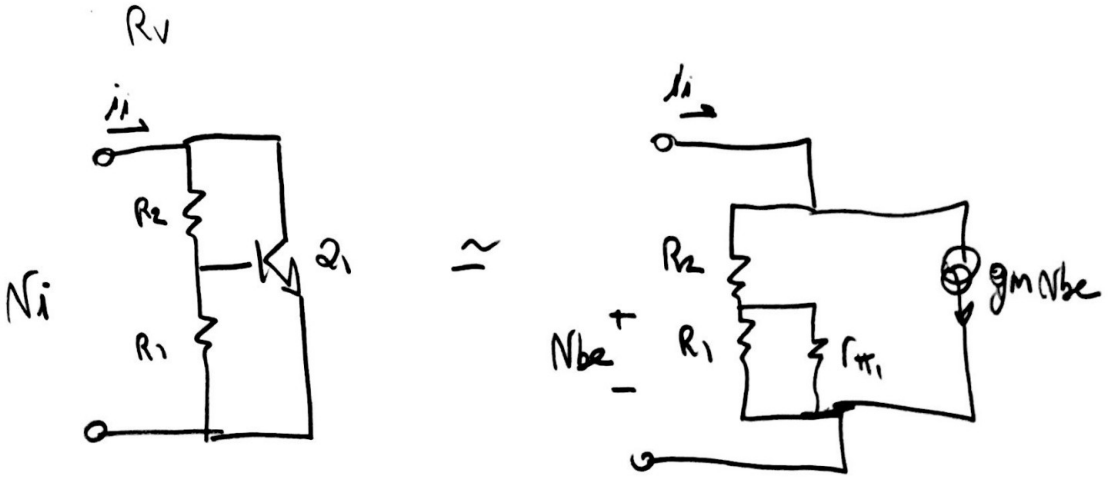
Clase AB


Vcc
IBIAS
QN
VBB
R2
IR
Q1
R1
RL
VI
-Vcc


Rv
ii
R2
Q1
Vi
R1
≃
ii
R2
gmVbe
Vbe
+
R1
rπ1
-

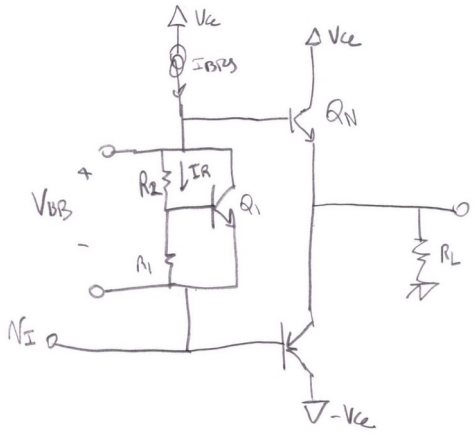
Clase AB

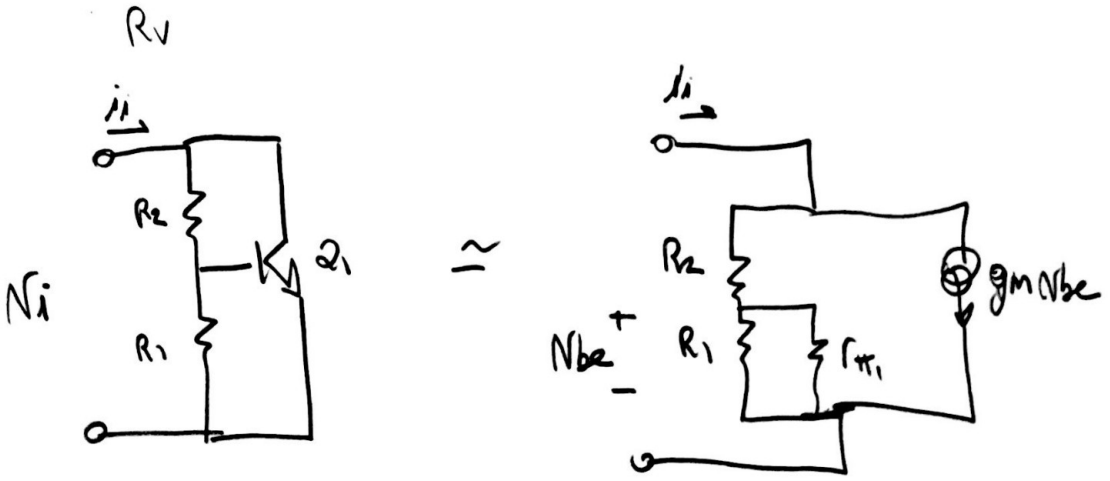




$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi 1}}{R_2 + R_1 /\!/ r_{\pi 1}}$$

Clase AB

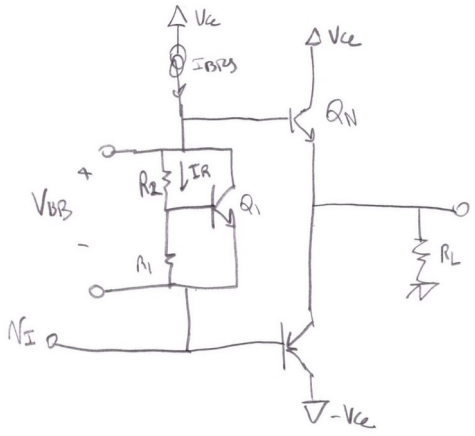


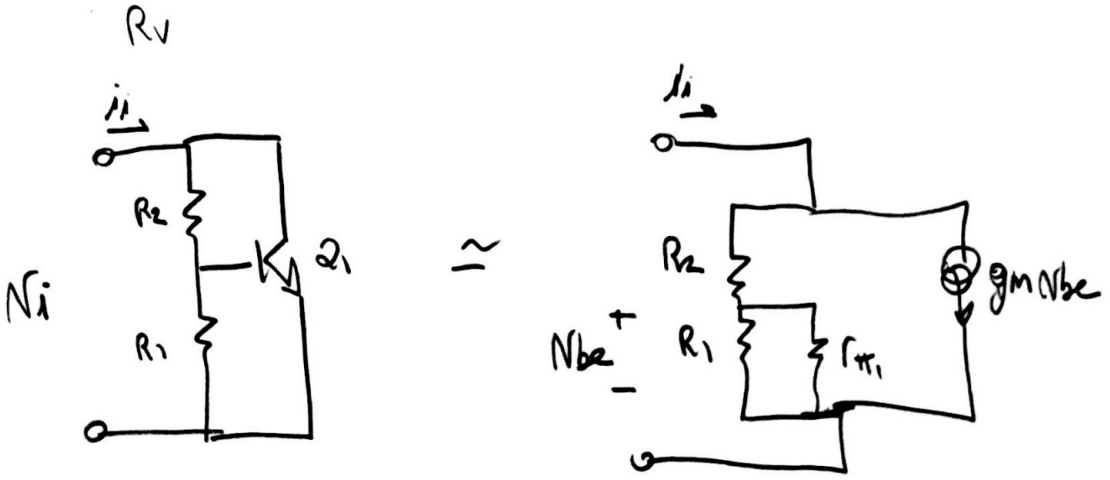


$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi 1}}{R_2 + R_1 /\!/ r_{\pi 1}}$$

$$i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi 1}} + g_{m1} V_{be_1} \right)$$

Clase AB

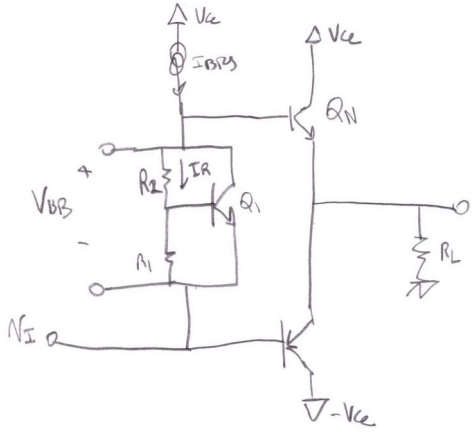


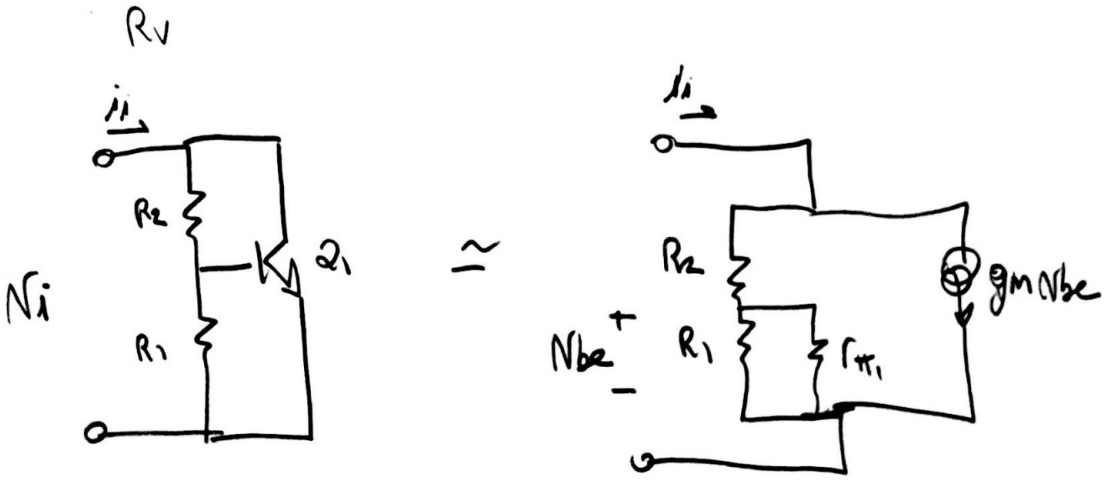


$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi_1}}{R_2 + R_1 /\!/ r_{\pi_1}}$$

$$i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + g_{m_1} V_{be_1} \right) \Rightarrow$$

Clase AB



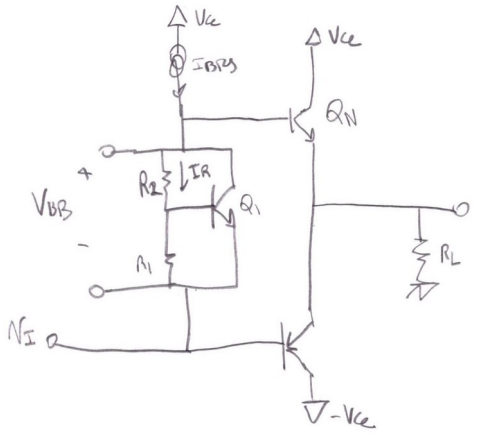


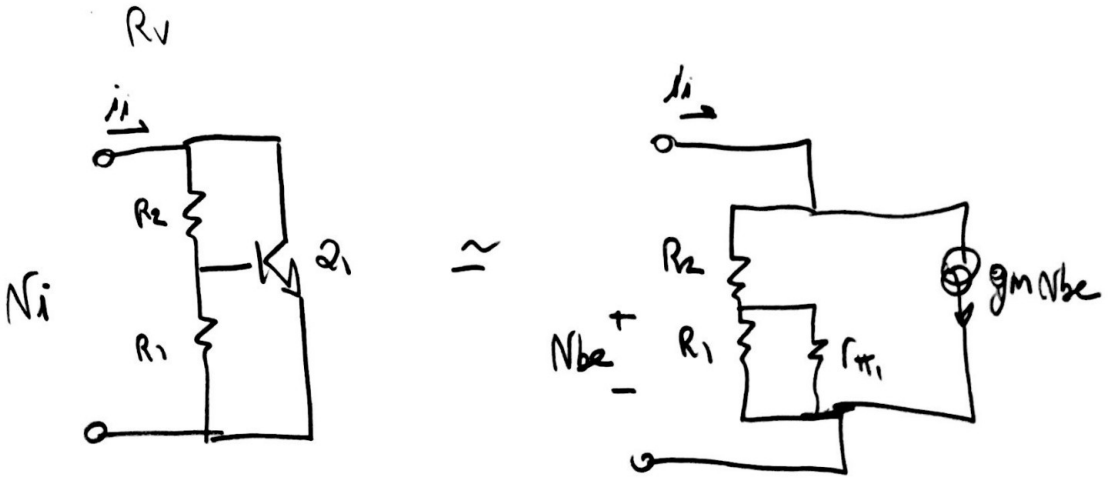
$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi_1}}{R_2 + R_1 /\!/ r_{\pi_1}}$$

$$i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + g_{m_1} V_{be_1} \right)$$

$$\Rightarrow i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + \frac{R_1 /\!/ r_{\pi_1} \, g_m}{R_2 + R_1 /\!/ r_{\pi_1}} \right)$$

Clase AB





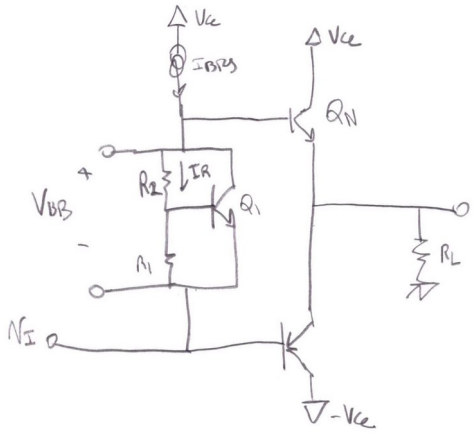
$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi_1}}{R_2 + R_1 /\!/ r_{\pi_1}}$$

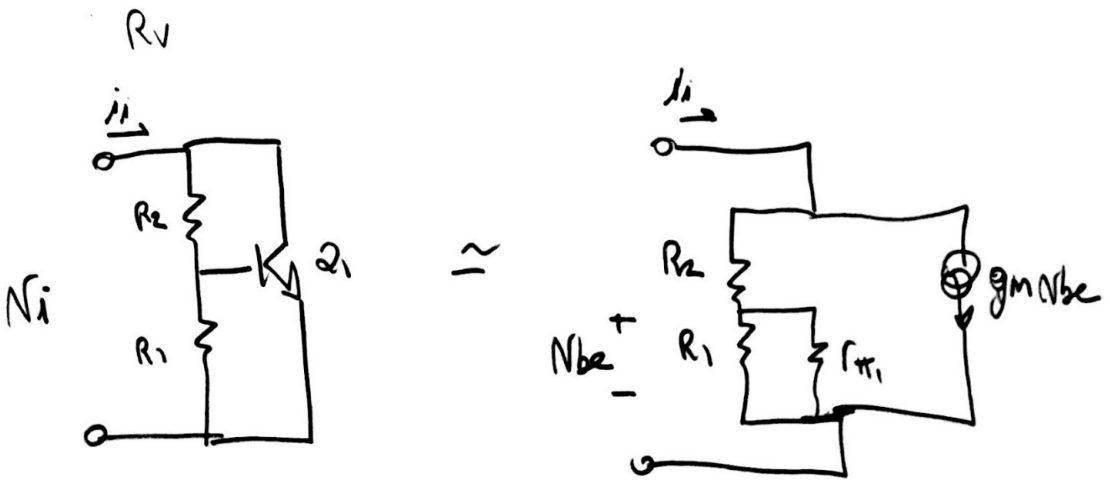
$$i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + g_{m_1} V_{be_1} \right)$$

$$\Rightarrow i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + \frac{R_1 /\!/ r_{\pi_1} \, g_m}{R_2 + R_1 /\!/ r_{\pi_1}} \right)$$

$$\Rightarrow R_i = \frac{V_i}{i_i} = \frac{R_2 + R_1 /\!/ r_{\pi_1}}{1 + (R_1 /\!/ r_{\pi_1}) g_m}$$

Clase AB





$$V_{be_1} = \frac{V_i \; R_1 /\!/ r_{\pi_1}}{R_2 + R_1 /\!/ r_{\pi_1}}$$

$$i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + g_{m_1} V_{be_1} \right)$$

$$\Rightarrow i_i = V_i \left(\frac{1}{R_2 + R_1 /\!/ r_{\pi_1}} + \frac{R_1 /\!/ r_{\pi_1} \, g_m}{R_2 + R_1 /\!/ r_{\pi_1}} \right)$$

$$\Rightarrow R_i = \frac{V_i}{i_i} = \frac{R_2 + R_1 /\!/ r_{\pi_1}}{1 + (R_1 /\!/ r_{\pi_1}) g_m}$$

Ej: $V_{BB} = 1{,}2$ $\quad I_{C_{min}} = 5\,mA$

$I_R = 500\,\mu A$ $\quad \beta = 200$

$R_1 = R_2$

$R_i \geq 10\,\Omega$