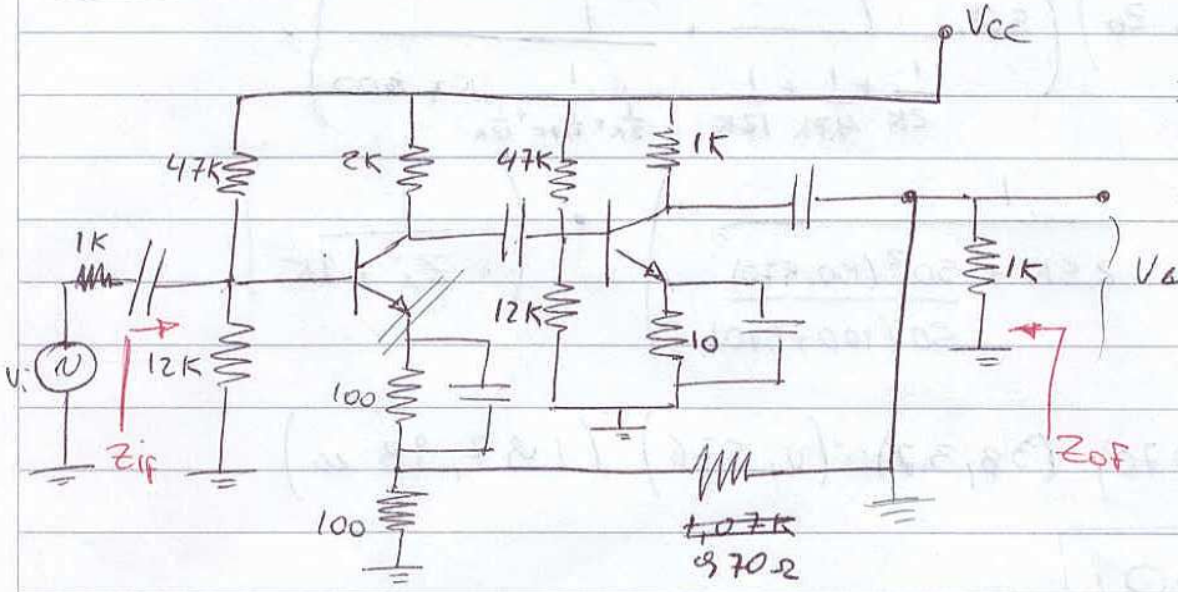
Ejecicio N° 5 — Tensión en Serie



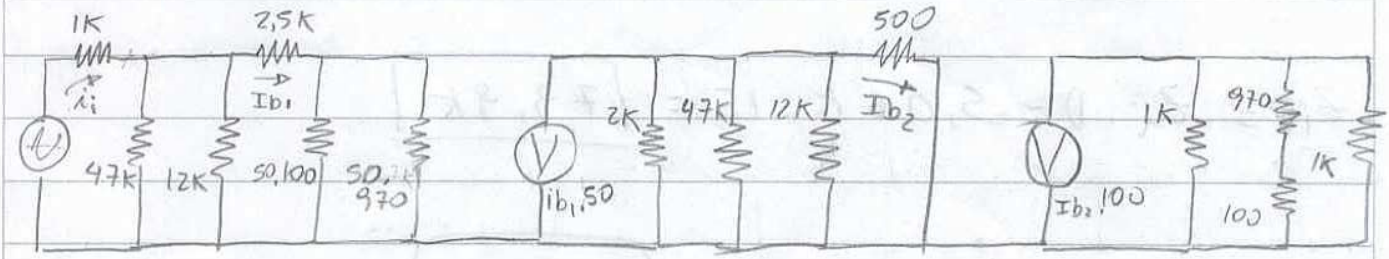
$I_{CQ_1} = 0{,}5mA$

$I_{CQ_2} = 5mA$

$h_{fe_1} = 50$

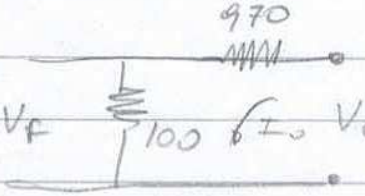
$h_{fe_2} = 100$

$h_{ie_1} = \frac{25mV \cdot h_{fe_1}}{I_{CQ}} = 2{,}5K$ $\qquad$ $h_{ie_2} = \frac{25mV \cdot h_{fe_2}}{I_{CQ_2}} = 500\Omega$



$$Z_i = \frac{1}{\frac{1}{47k} + \frac{1}{12k} + \left[\frac{1}{2{,}5K + 50^2(100 \,\|\, 970)}{50(100+970)}\right]} = 4{,}051\ K\Omega$$

$$Z_o = \frac{1}{\frac{1}{1K} + \frac{1}{1K} + \frac{1}{970+100}} = \boxed{340{,}7\Omega}$$



$$\beta = \frac{X_F}{X_O} = \frac{100}{100+970} = \boxed{93{,}45 \cdot 10^{-3}}$$

NOTA

$$\Delta V = \frac{V_L}{V_i} = \frac{V_L}{i_{b_2}} \cdot \frac{i_{b_2}}{i_{b_1}} \cdot \frac{i_{b_1}}{i_i} \cdot \frac{i_i}{V_i}$$

$$= (100 . Z_o)\left(50 . \frac{1}{\frac{1}{2K}+\frac{1}{47K}+\frac{1}{12K}} \cdot \frac{1}{\frac{1}{\frac{1}{2K}+\frac{1}{47K}+\frac{1}{12K}} + 300}\right) \cdot$$

$$\cdot \left(Z_i . \frac{1}{2,5K + \frac{50^2 (100.970)}{50(100+970)}}\right) \cdot \left(\frac{1}{Z_i + 1K}\right)$$

$$= (34070)\ (38,37)\ (0,576)\ (197,98\ \mu)$$

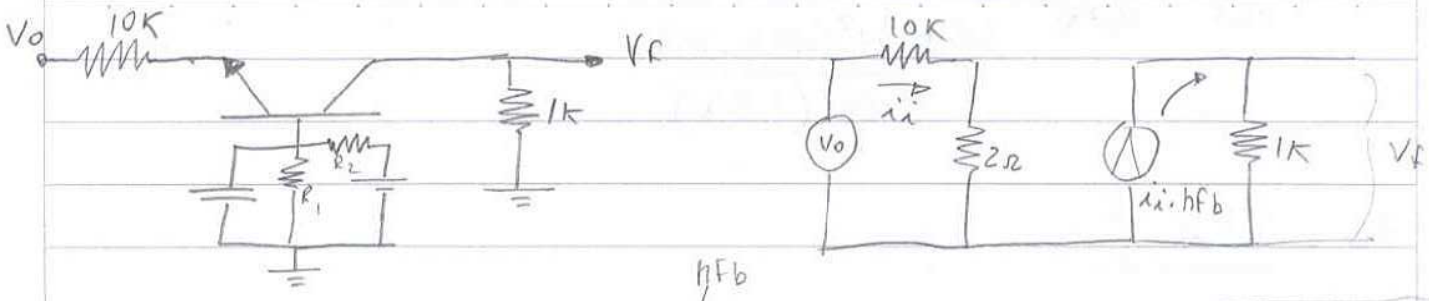
$$= \boxed{150}$$

$$D = 1 + \beta . \Delta V = 1 + 93,45 . 10^{-3} . 150 = \boxed{15}$$

$$Z_{if} = Z_i . D = 5,06K . 15 = \boxed{79,9K}$$

$$Z_{of} = \frac{Z_o}{D} = \frac{340,7}{15} = \boxed{22,7\Omega}$$

NOTA



$$\beta = \frac{V_f}{V_o} \Rightarrow \Delta v = \frac{V_f}{i_i} \cdot \frac{i_i}{V_o} = \left(\frac{100}{101} \cdot 1K\right)\left(\frac{1}{10K+2}\right) = \boxed{98,99 \cdot 10^{-3}}$$

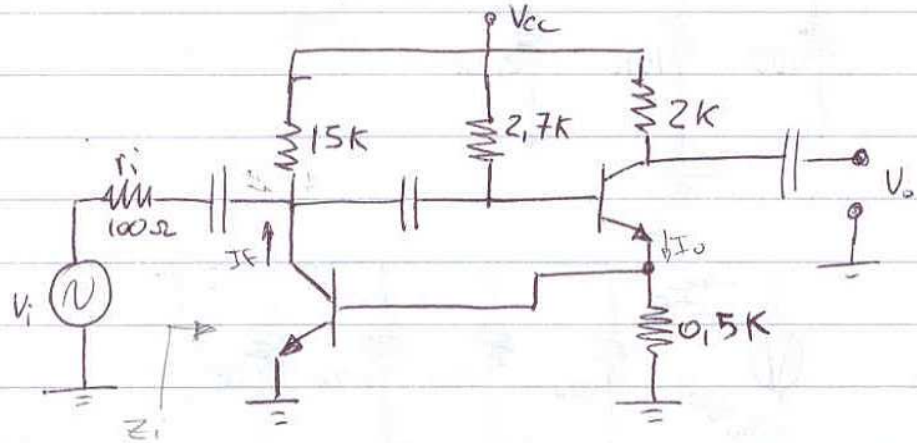
($\frac{100}{101}$ = h_{fb})

$$D = 1 + \beta \Delta v = 1 + 98,99 \cdot 10^{-3} \cdot 26,7 = \boxed{3,64}$$

$$z_{if} = z_i \cdot D = 50K \cdot 3,64 = \boxed{182,15K}$$

$$z_{of} = \frac{z_o}{D} = \frac{833,34}{3,64} = \boxed{228,7\,\Omega}$$

Ejercicio Nº 12 (Parcial) ???



$h_{ie} = 1K\Omega$

$h_{fe} = 50$

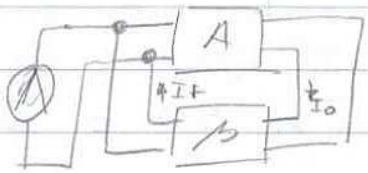
$\Delta v = ?$

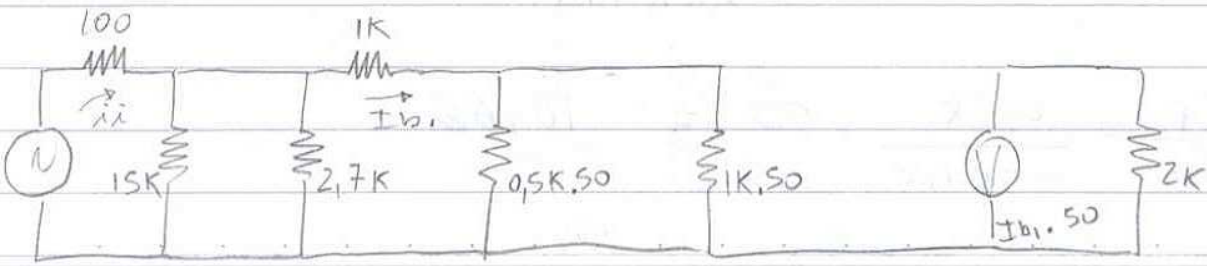
$z_{if} = ?$

$z_{of} = ?$

Corriente en Paralelo

Entrada $\Rightarrow$ $Y_o = 0$ Salida $= V_i = 0$





NOTA

$$z_i = \frac{1}{\frac{1}{15K} + \frac{1}{2,7K} + \frac{1}{1K + \frac{50^2 (0,5K \cdot 1K)}{50\,(1,5K)}}} = \boxed{2025\ \Omega}$$

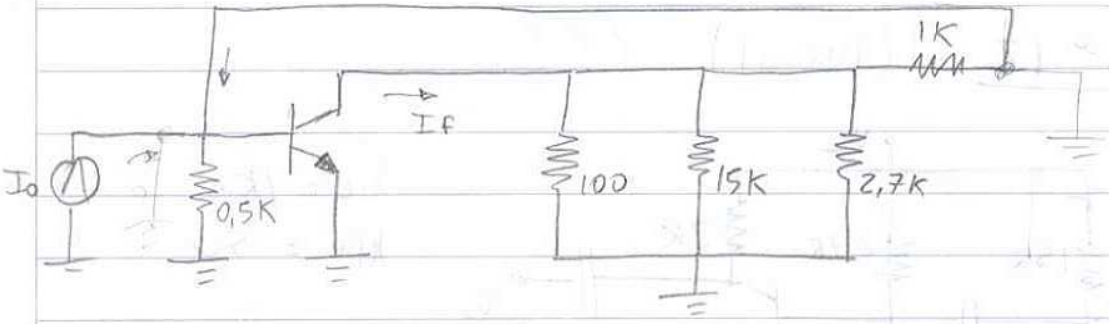
$$z_o = \boxed{2K}$$

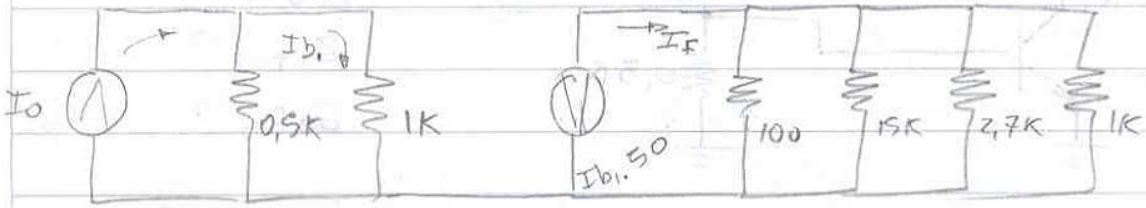
$$\Delta V = \frac{V_L}{V_i} = \frac{V_L}{ib_1} \cdot \frac{ib_1}{V_i} = (50.2K) \left[\frac{z_i}{(z_i + 100)} \cdot \frac{1}{1K + \frac{50^2 (0,5K \cdot 1K)}{50\,(1,5K)}} \right]$$

$$= (10^5)\,(53,94 \cdot 10^{-6}) = \boxed{5,39}$$

$$\beta = \frac{X_f}{X_o} = \frac{I_f}{I_o} =$$

Tensión en N
Entrada $\Rightarrow V_o = 0$
Salida $\Rightarrow V_i = 0$





$$I_f = I_{b_1} \cdot 50 = I_o \cdot \left(\frac{0,5K}{0,5K + 1K} \right) \cdot 50$$

$$\beta = \frac{I_f}{I_o} = \frac{0,5K}{0,5K + 1K} \cdot 50 = 16,66$$

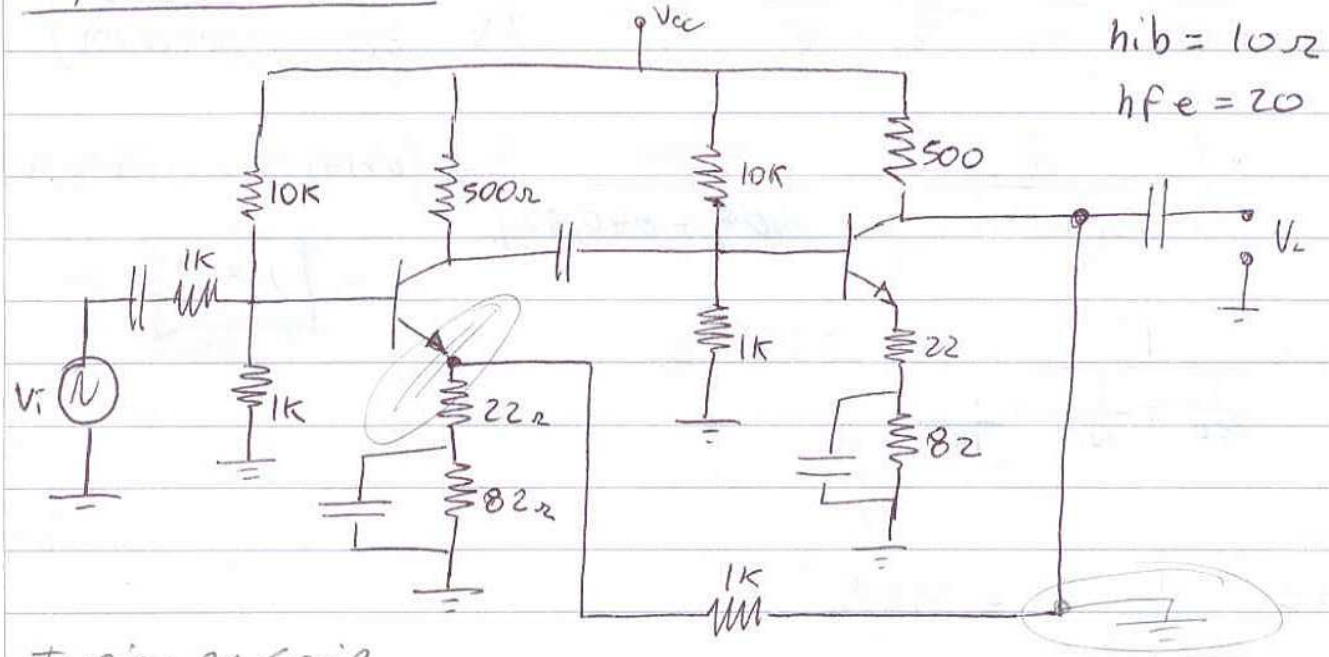
NOTA

$D = 1 + \beta \Delta I = 1 + 16,66 \cdot 5,39 = \boxed{90,83}$

$Z_{if} = \frac{Z_i}{D} = \frac{2025}{90,83} = \boxed{22,3\ \Omega}$

$Z_{of} = Z_o \cdot D = 2K \cdot 90,83 = \boxed{181,86\ K\Omega}$

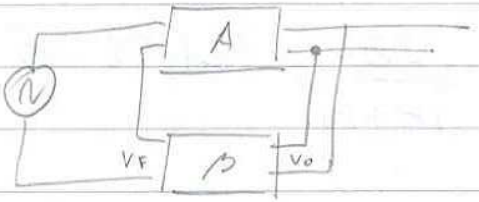
Ejercicio N° 13:



$h_{ib} = 10\ \Omega$

$h_{fe} = 20$

Tensión en serie

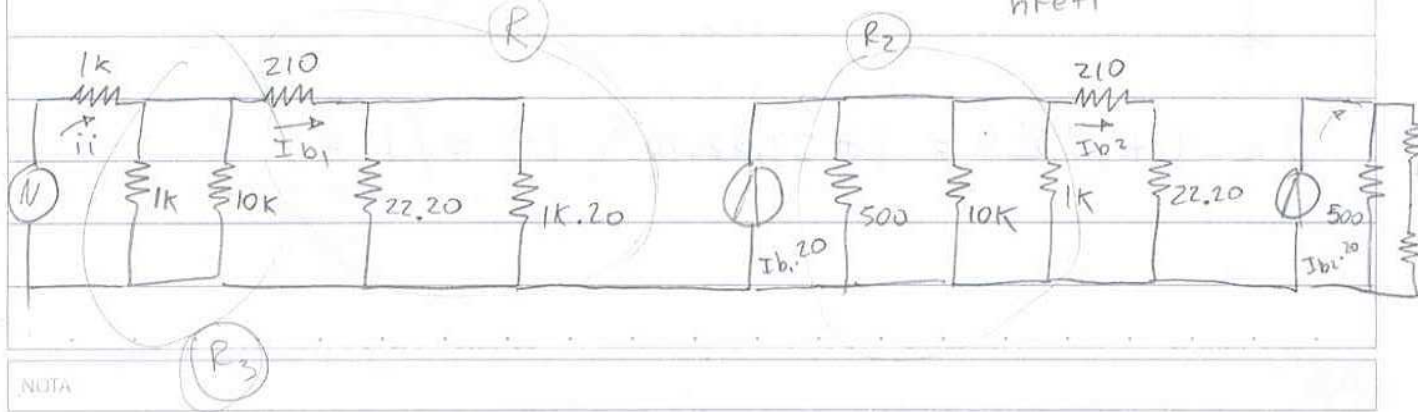


$\beta = \frac{V_F}{V_o}$

Entrada $\Rightarrow V_o = 0$

Salida $\Rightarrow I_i = 0$

$h_{ib} = \frac{h_{ie}}{h_{Fe}+1} \Rightarrow h_{ie} = 10.21 = (21$



NOTA

$$R_1 = 210 + \frac{22.20^2.1K}{20(22+1K)} = 640,52$$

$$Z_i = \frac{1}{\frac{1}{1K} + \frac{1}{10K} + \frac{1}{640,52}} = \boxed{375,7\ \Omega}$$

$$Z_o = \frac{1}{\frac{1}{500} + \frac{1}{1K+22}} = \boxed{335,7\ \Omega}$$

426 μ

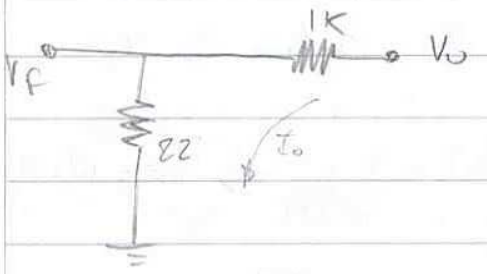
$$\Delta V = \frac{V_o}{V_i} = \frac{V_o}{i_{b2}} \cdot \frac{i_{b2}}{i_{b1}} \cdot \frac{i_{b1}}{V_i} = \left(20.70\right)\left(20.\frac{322,58}{322,58+(210+22.20)}\right)$$

$$\cdot\left(\frac{1}{(Z_i+1K)} \cdot \frac{909}{909+640,52}\right) = (6714)\,(6,63)\,(426,42.10^{-6})$$

$$= \boxed{19}$$

$$R_2 = \frac{1}{\frac{1}{500} + \frac{1}{10K} + \frac{1}{1K}} = 322,58$$

$$R_3 = \frac{1}{\frac{1}{1K} + \frac{1}{10K}} = \boxed{909}$$



$$\beta = \frac{V_f}{V_o} = \frac{22}{1K+22} = \boxed{21,52.10^{-3}}$$

$$D = 1 + \beta\Delta V = 1 + 21,52.10^{-3}.\ 19 = \boxed{1,41}$$

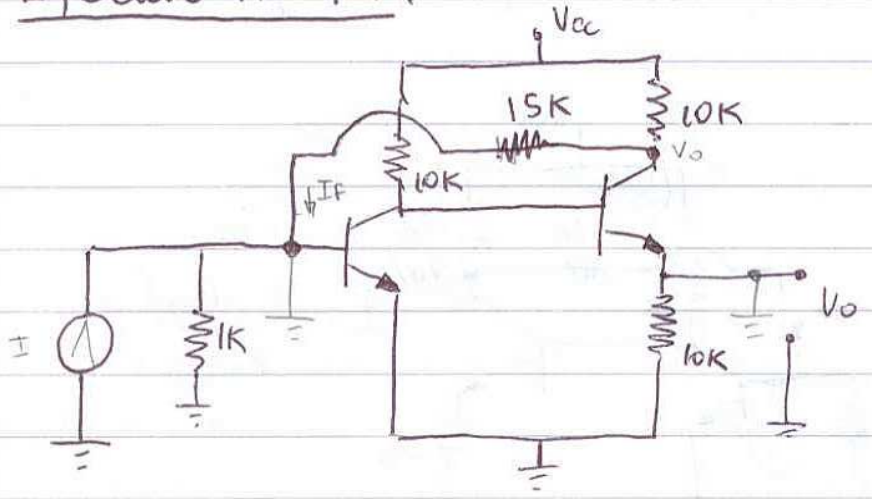
NOTA

$$Z_{oF} = \frac{Z_o}{D} = \frac{335,7}{1,41} = \boxed{238,2\ \Omega}$$

$$Z_{iF} = Z_i \cdot D = 375,7 \cdot 1,41 = \boxed{529,3\ \Omega}$$

$$\Delta v_f = \frac{\Delta v}{D} = \frac{19}{1,41} = \boxed{13,48}$$

Ejercicio Nº 14:



$h_{fe} = 50$

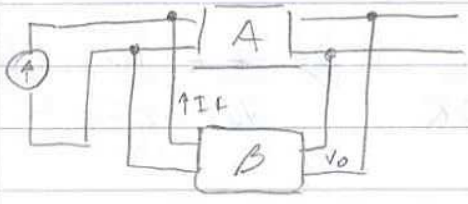
$h_{ie} = 2K$

$\Delta_{iF} = ?$

$\Delta_{vF} = ?$

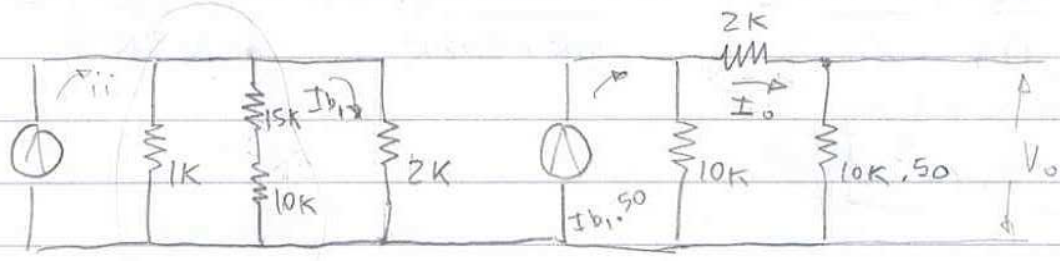
$R_{iF} = ?$

Tension en Paralelo



$$\beta = \frac{X_F}{X_o} = \frac{I_F}{V_o} =$$

Entrada $\Rightarrow V_o = 0$ Salida $\Rightarrow V_i = 0$



NOTA

$1K // 25K = 961,5\ \Omega$ $I_{b1} \cdot i_i \cdot Z_i = V_i$

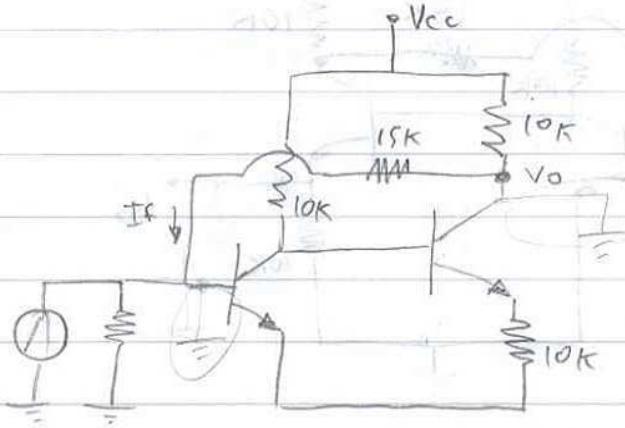
$$Z_i = \frac{1}{\frac{1}{1K} + \frac{1}{25K} + \frac{1}{2K}} = \boxed{649,3\ \Omega}$$

$$Z_o = \frac{1}{\frac{1}{10K} + \frac{1}{2K + 50 \cdot 10K}} = \boxed{9,8\ K\Omega}$$ ← (No es la Zo verdadera)

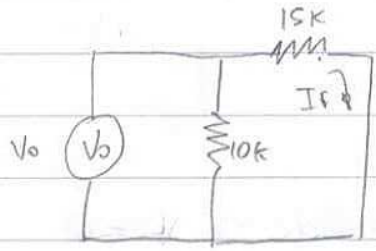
$$\Delta_V = \frac{V_o}{V_i} = \frac{V_o}{i_{b_1}} \cdot \frac{i_{b_1}}{V_i} = (50 \cdot Z_o)\left(\frac{1}{2K}\right) = \boxed{245}$$

$$\Delta_I = \frac{I_o}{I_i} = \frac{I_o}{i_{b_1}} \cdot \frac{i_{b_1}}{i_i} = \left(\frac{50 \cdot Z_o}{2K + 500K}\right)\left(\frac{Z_i}{2K}\right) = \boxed{0,3168}$$

$$\beta = \frac{I_f}{V_o}$$



Tensión en Bobina
entrada → Vo = 0
salida → Vi = 0



$$\Rightarrow I_f = V_o \cdot \frac{10K}{25K} \Rightarrow \frac{I}{V_o} = \frac{10}{25} = \boxed{0,4}$$

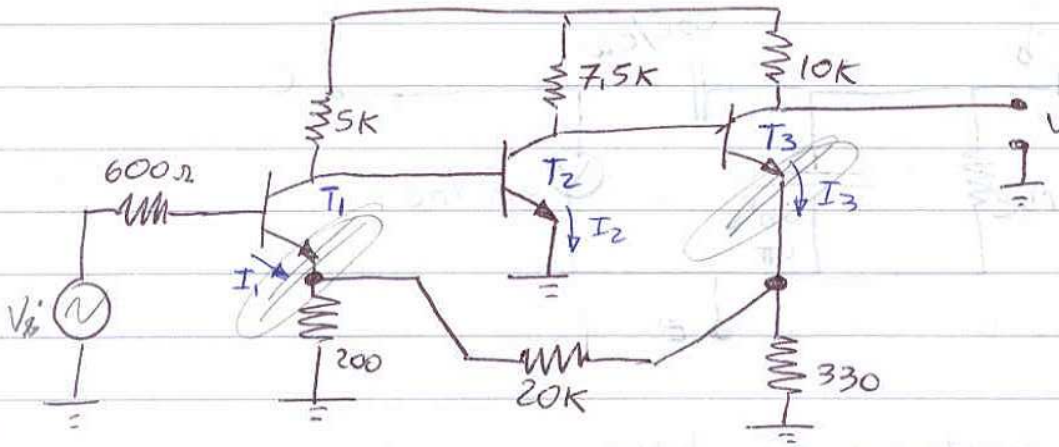
$$R_m = \frac{V_o}{i_i} = \frac{V_o}{i_{b_1}} \cdot \frac{i_{b_1}}{i_i} = \left(50 \cdot \frac{10K}{10K + 502K} \cdot 502K\right) \cdot \left(\frac{Z_i}{2K}\right) =$$

$$= \boxed{159,15 \cdot 10^3}$$

NOTA

Ejercicio N° 15 :

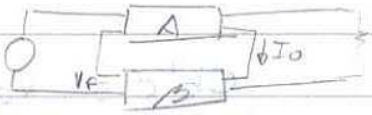
Ie



$I_1 = 250\mu A$
$I_2 = 1mA$
$I_3 = 500\mu A$

$h_{fe} = 100$ (Tab

Corriente en serie



$\beta = \frac{X_f}{X_o} = \frac{V_f}{I_o}$

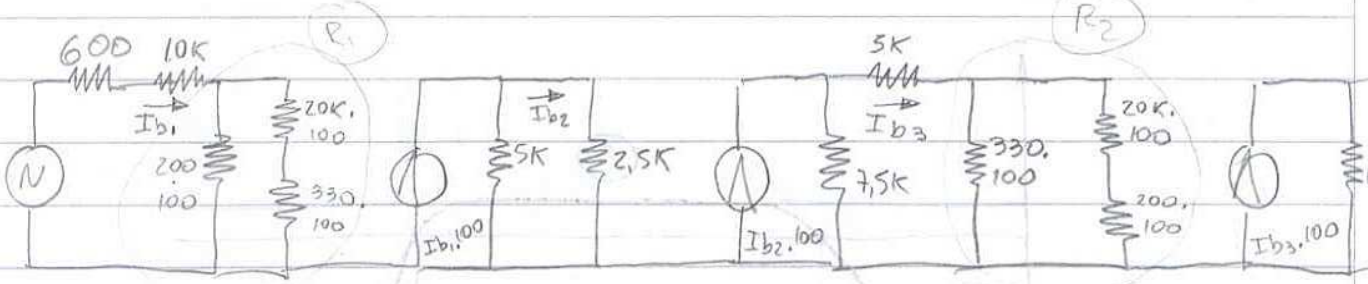
Entrada $\Rightarrow I_o = 0$

Salida $\Rightarrow I_i = 0$

$$h_{ie_1} = \frac{25mV \cdot h_{fe}}{I_{CQ}} = \frac{25mv \cdot 100}{250\mu A} = 10K$$

$$h_{ie_2} = \frac{25mv \cdot 100}{1mA} = 2,5K$$

$$h_{ie_3} = \frac{25mv \cdot 100}{500\mu A} = 5K$$

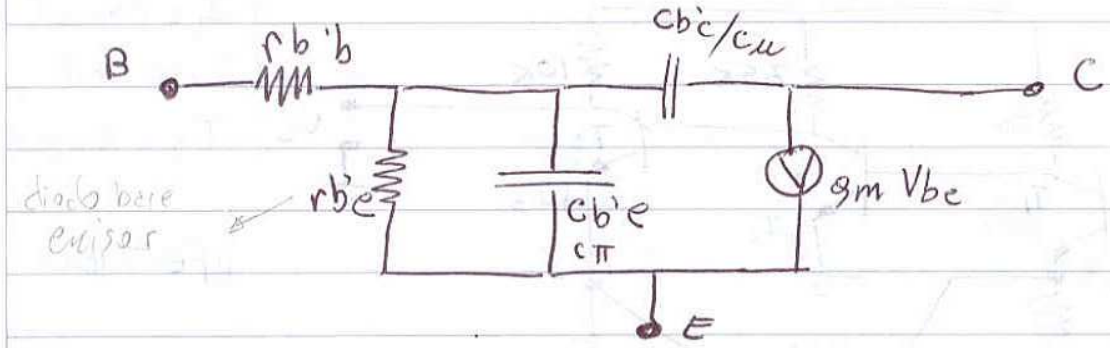


$R_1 =$

NOTA

Respuesta en frecuencia.

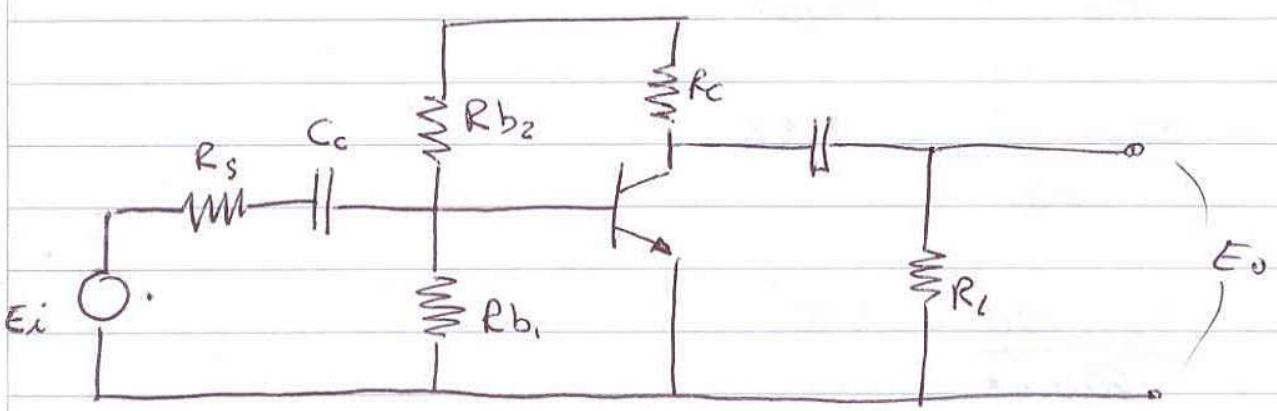
Modelo "π" (otro es el H)

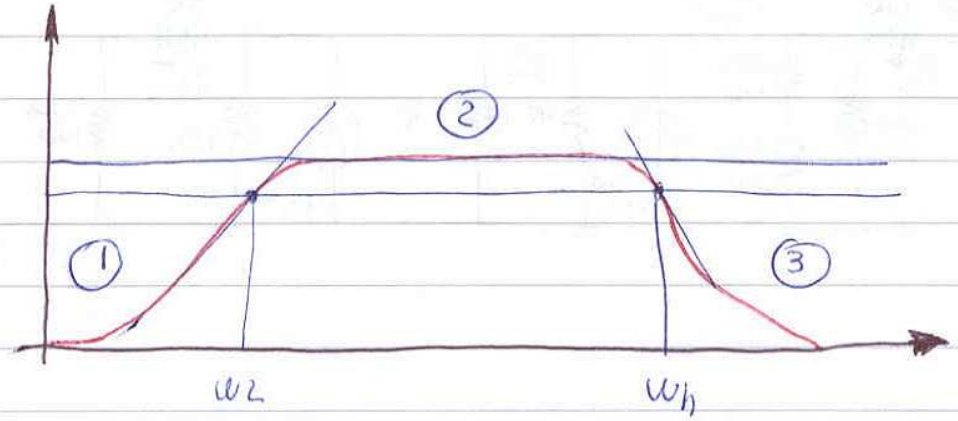


$r_{b'b} = r_x$ = resistencia dif. base

$r_{b'e} = \frac{h_{fe}}{40\, I_{EQ}}$ $\qquad C_{b'c} = V_{CB}^{(1/p)}$

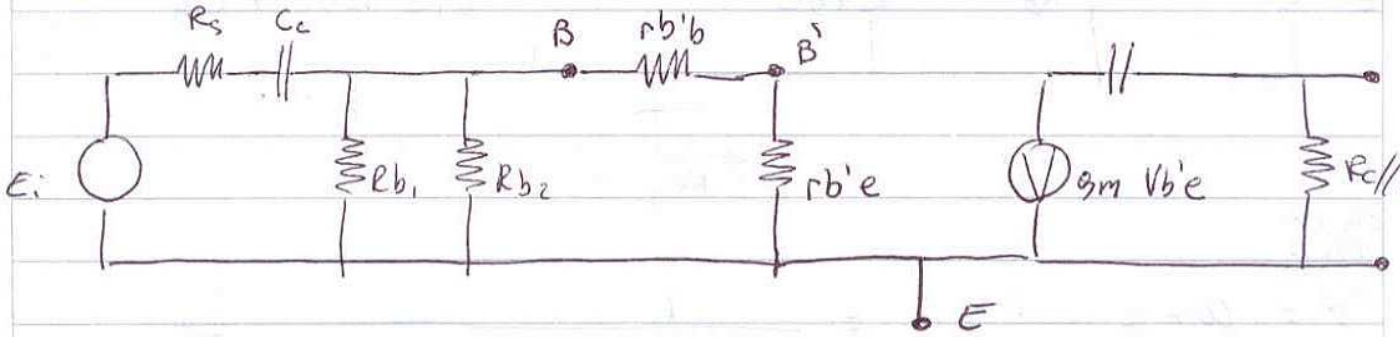
$C_{b'e} = C_\pi = \frac{g_m}{\omega_T}$ $\qquad g_m = I_{EQ} \cdot 40 = \frac{I_{EQ}}{25\,mV}$



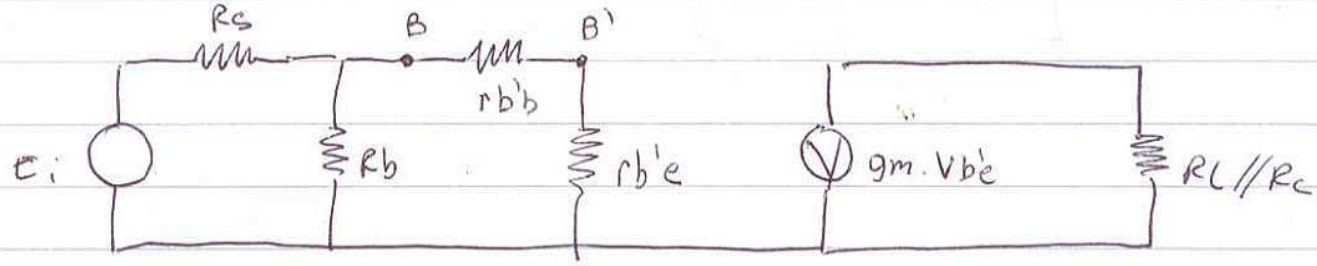


NOTA

① Circuito equivalente p/ Baja Frecuencia. (ω_L)

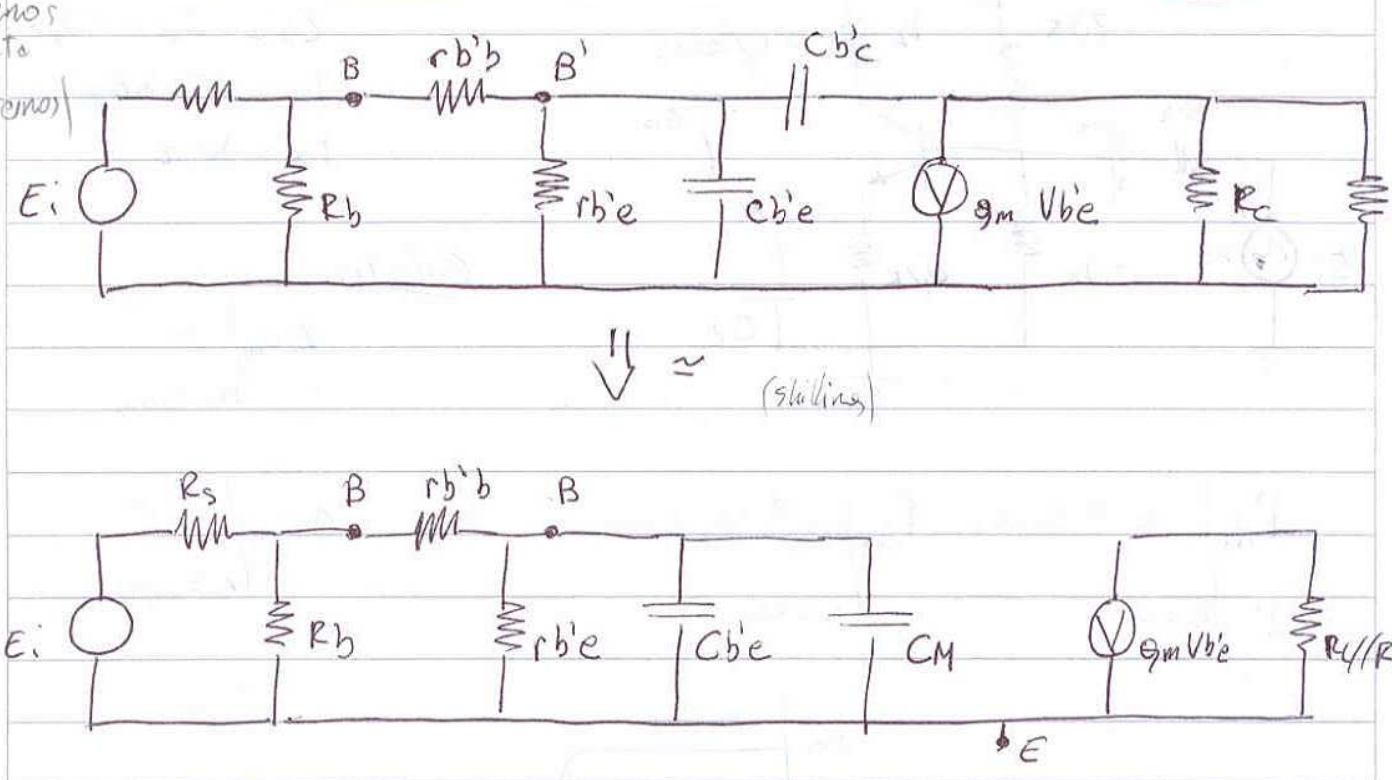


② Circuito equivalente p/ Frecuencias Medias. (ΔV_m)



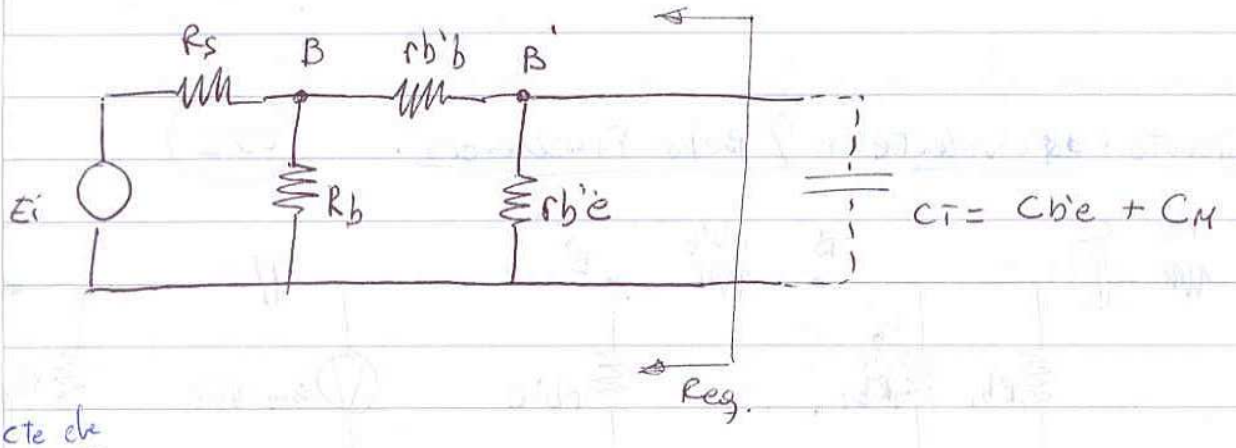
③ Circuito equivalente para alta frecuencia. (ω_h)

(no tenemos en cuenta los cap. externos)



(CAPACIDAD DE MILLER) $C_M = C_{b'c}\,(1 + g_m\, R_L // R_c)$

NOTA

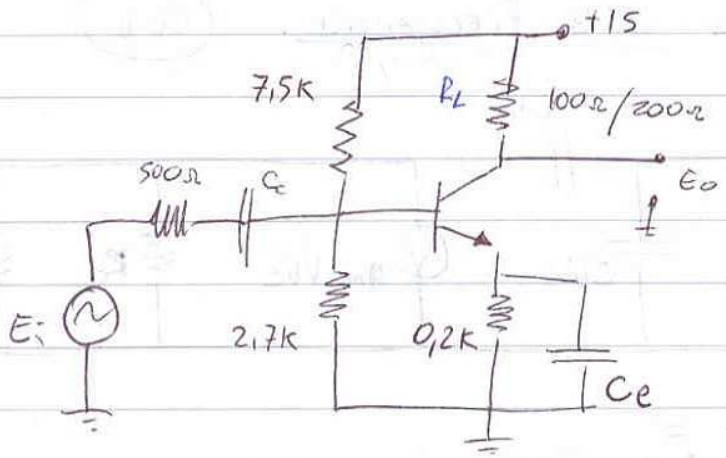


Cte de Tiempo

$$\alpha = \omega_H = \frac{1}{R_{eq} \cdot C_T} = \frac{1}{R_{eq}\left[C_{b'e} + C_{b'c}\left(1 + g_m R'_L\right)\right]}$$

$$R_{eq} = r_{b'e} \,//\, \left[r_{b'b} + (R_S // R_b) \right]$$

Ejercicio N.º 1 : Resp. en Frec.



Datos: $h_{fe} = 80$

$C_{b'e} = C_\mu = 3,5pF$

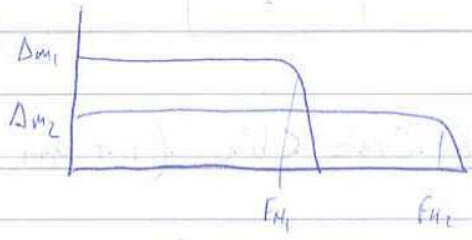
$f_T = 750\,MHz$

$r_x = 30\,\Omega$

Calcular:

$\Delta V_{M_1}\Big|_{R_L=100\Omega} = ?$

$f_{H_1}\Big|_{R_L=100} = ?\ 5,6\,MHz$ $f_{H_2}\Big|_{R_L=200} = ?\ 3,68\,MHz$ $\Delta V_{M_2}\Big|_{R_L=200\Omega} = ?$

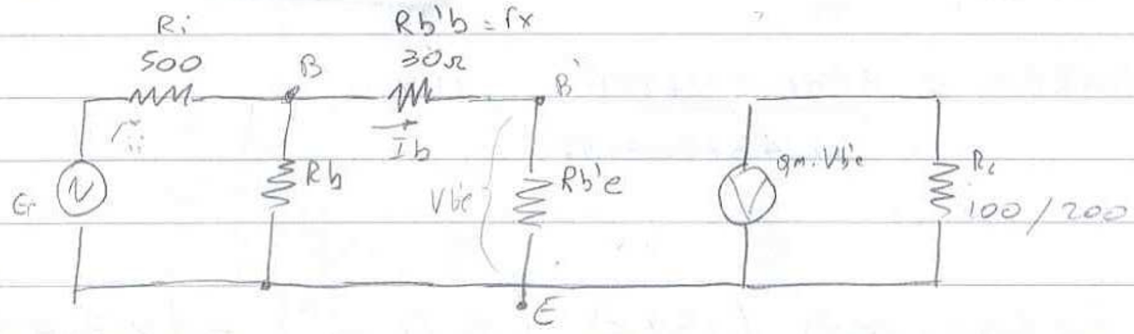


NOTA

[redacted]

Frecuencias Medias

$V_{bb} - V_{be} = (I_b)(R_b + R_e \beta)$



$$R_b = R_{b1} // R_{b2} = \left(\frac{7{,}5 \cdot 2{,}7}{7{,}5 + 2{,}7}\right) K = \boxed{1{,}98K}$$

$$V_{bb} = \frac{V_{cc}}{R_1 + R_2} \cdot R_1 = \frac{15}{(7{,}5+2{,}7)} \cdot 2{,}7 = \boxed{3{,}97\,v}$$

$$I_{CQ} = \frac{V_{bb} - V_{be}}{\frac{R_b}{\beta} + R_e} = \frac{3{,}97 - 0{,}7}{\frac{1{,}98K}{80} + 0{,}2K} = \boxed{14{,}55\,mA}$$

$$R_{b'e} = \frac{h_{fe}}{40\, I_{CQ}} = \frac{25mv \cdot h_{fe}}{I_{CQ}} = \frac{25mV \cdot 80}{14{,}55mA} = \boxed{137{,}5\,\Omega}$$

$$g_m = \frac{I_{CQ}}{25mv} = \frac{14{,}55mA}{25mv} = 0{,}582$$

$$AV_m = \frac{V_L}{V_i} = \left(\frac{V_L}{V_{b'e}}\right) \cdot \left(\frac{V_{b'e}}{i_b}\right) \left(\frac{i_b}{V_i}\right) = (g_m\, R_c)\,(R_{b'e})\left(\frac{R_b // (R_{b'b} + R_{b'e})}{[R_i + R_b // (R_{b'b} + R_{b'e})] \cdot [R_{b'b} + R_{b'e}]}\right)$$

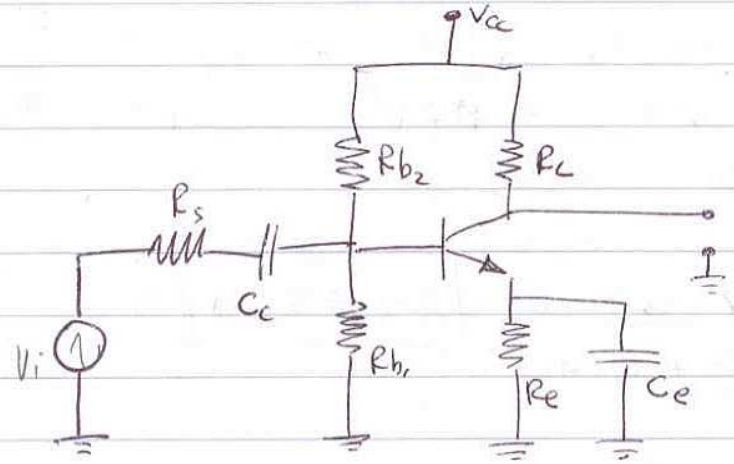
$$\Delta V_{m_1} = (0{,}582 \cdot 100)\left(137{,}5\right)\left(\frac{154}{(500+154)\cdot(30+137)}\right)$$

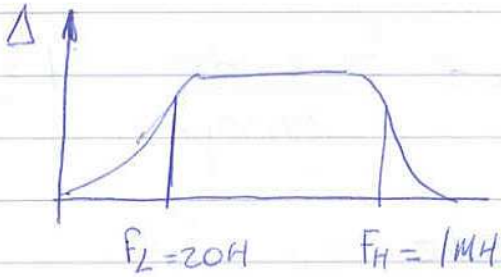
$$= (58{,}2)\,(137{,}5)\,(1{,}41\cdot 10^{-3}) = \boxed{11{,}25}$$

$$Rb \,//\, (Rb'b + Rb'e) = \frac{1{,}98K \cdot (30+137)}{1{,}98+30+137} = 154$$

$$\Delta V_{m_2} = (0{,}582 \cdot 200)\,(137{,}5)\,(1{,}41\cdot 10^{-3}) = \boxed{22{,}48}$$

(FALTA, está MAS ADELANTE) ⊗





15/08/06

Datos: $R_S = 1K$

$Re = 0{,}3K$

$Rb_1 // Rb_2 = 10K$

$I_{CQ} = 2{,}5mA$

$V_{CEQ} = 5V$

$hfe = 40$

$rb'b = 100\Omega$

$f_T = 200MHz$

$Cb'c = 5pF$

Calcular C_c, C_e, V_{cc}, R_L

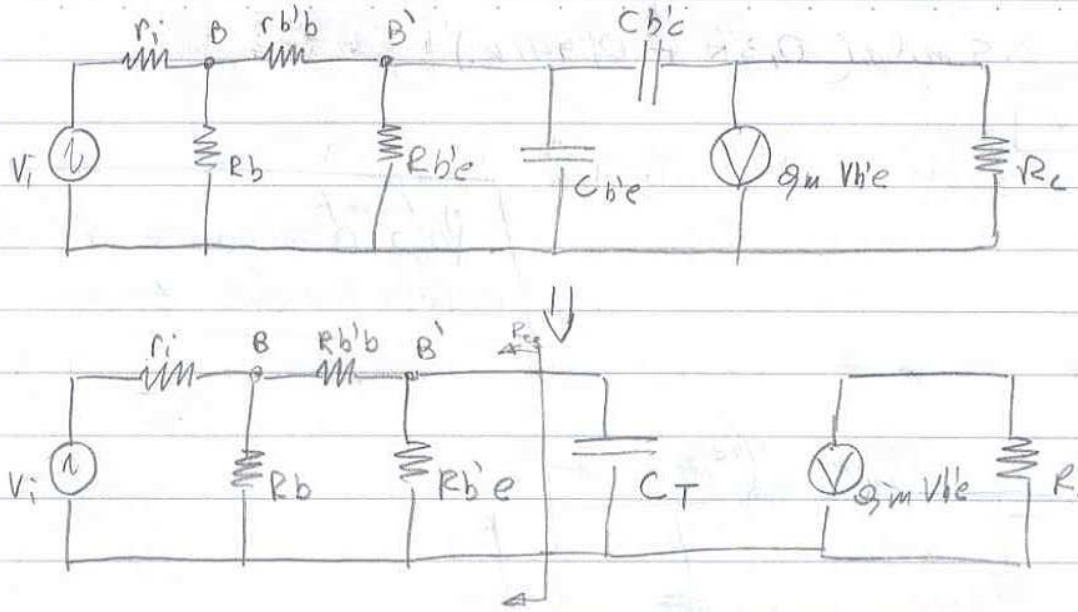
10 µF 500 µF 8,1 V 934

$R_L \Rightarrow$ en función de f_H

HOJA Nº 17

FECHA

Alto F → ~~Re~~



$$C_T = C_{b'e} + C_M = C_{b'e} + C_{b'c}\left(1 + g_m R_L\right) \Rightarrow$$

⑥ $$R_L = \left(\frac{C_T - C_{b'e}}{C_{b'c}} - 1\right)\frac{1}{g_m} = \left(\frac{555.10^{-12} - 79,6.10^{-12}}{5.10^{-12}} - 1\right)\frac{1}{0,1} = \boxed{941\,\Omega}$$

④ $$\omega_H = \frac{1}{R_{eq}.C_M} \Rightarrow C_M = \frac{1}{R_{eq}.2\pi f_H} = \frac{1}{286.2\pi.1MHz} = \boxed{555\,pF}$$

② $$R_{eq} = R_{b'e} // \left[R_{b'b} + (R_i // R_b)\right]$$
$$= 400 // \left[100 + (1K // 10K)\right]$$
$$= \boxed{286}$$

① $$R_{b'e} = \frac{h_{fe}}{40\, I_{cq}} = \frac{40}{40.2,5mA} = 400\,\Omega$$

③ $$g_m = \frac{I_{EQ}}{25mV} = \frac{2,5mA}{25mV} = 0,1$$

⑤ $$C_{b'e} = \frac{g_m}{\omega_T} = \frac{g_m}{2\pi.f_T} = \frac{0,1}{2\pi.200MHz} = \boxed{79,6\,pF}$$

NOTA

$$V_{cc} = V_{CE_Q} + I_{CQ}\,(R_e + R_L)$$

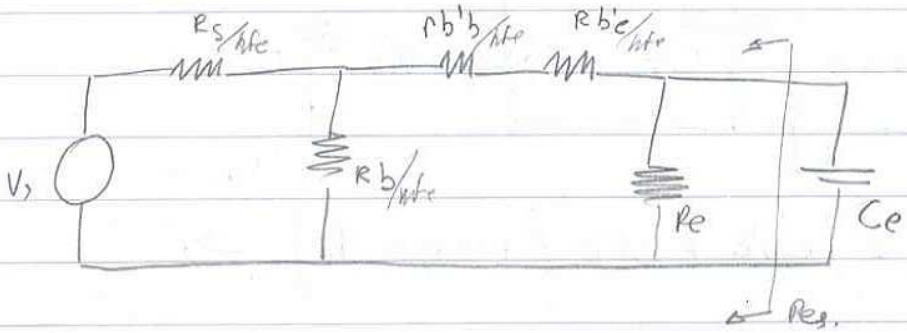
$$= 5v + 2{,}5\,mA\,(0{,}3K + 0{,}941K)$$

$$\boxed{V_{cc} = 8{,}10\,v}$$

Polo dominante el del capacitor de Emisor

P/ BF

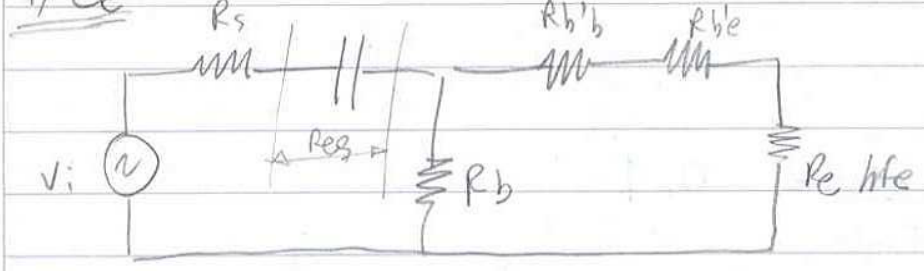
P/ $\omega_L = \omega_{Ce}$



$$\omega_L = \frac{1}{Req \cdot Ce} \Rightarrow Ce = \frac{1}{\omega_L\, Req}$$

$$Req = Re \,//\, \frac{(rb'b + Rb'e) + Rb\,//\,Rs}{hfe+1} =$$

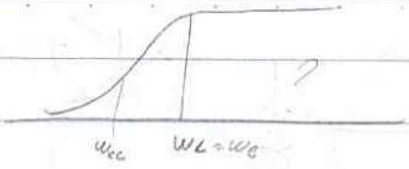
P/ Ce



$$X_{Ce} = \frac{1}{\omega\, Ce}$$

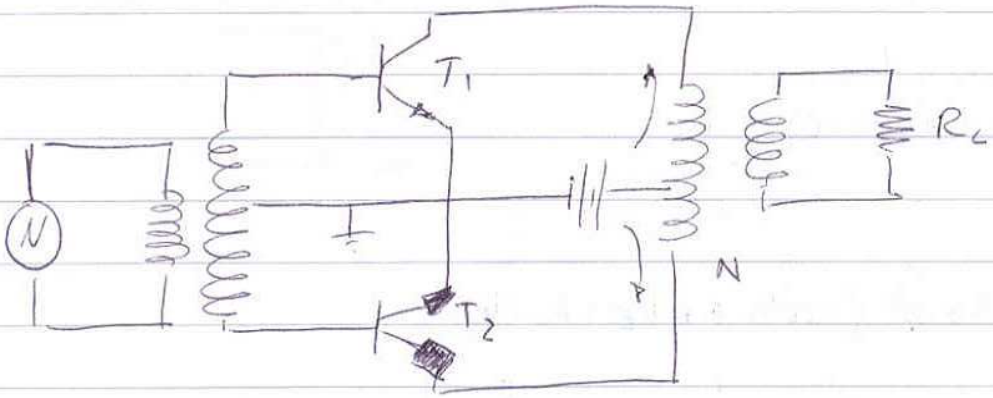
NOTA

$$\omega_{cc} = \frac{\omega_L}{10} = \frac{1}{Req \cdot C_c}$$



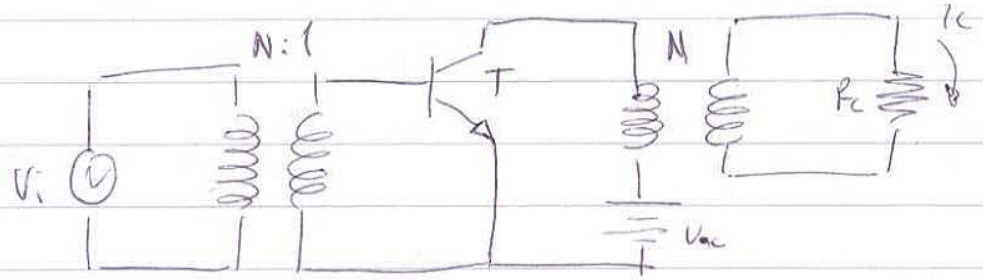
$$Req = Rs + Rb \,//\, (Rb'b + Rb'e + Re\,hfe)$$

Amplificadores de Potencia "Clase B"



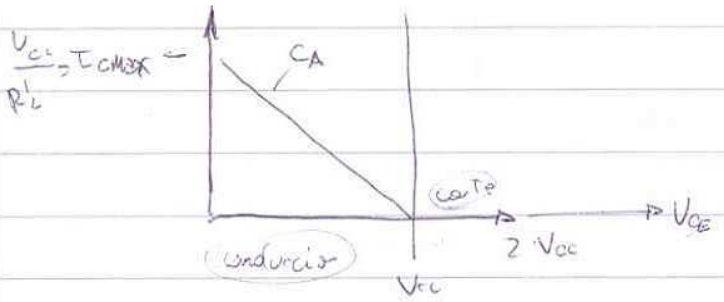
Push - Pull

$R'_L = N^2 R_L$



Para CC $V_{cc} = V_{CE}$

P/CA $\Rightarrow$ $V_{cE} = V_{cc} + N \cdot V_L$



Si T_V conduce $V_{CE} = 0$

$V_{cc} = -N V_L$

$V_{cc} = I_{cmax} R'_L$

$I_{cm} = \frac{V_{cc}}{R'_L}$

Ecuaciones de Potencia:

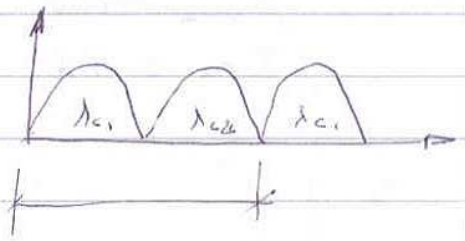
$$P_{cc} = 2 P_c + P_L$$

Potencia en fuente — Pot en colector — Pot. en carga

NOTA

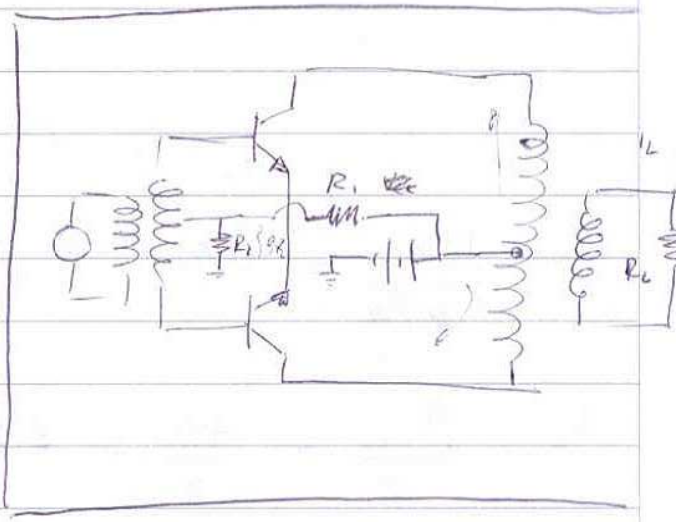
Pot. suministrada por la fuente:

$$P_{cc} = \frac{2}{\pi} \frac{V_{cc}^2}{R'_L} = 0,636 \frac{V_{cc}^2}{R'_L}$$



Pot max en carga:

$$P_{L\,max} = \frac{V_{cc}^2}{2\,R'_L}$$



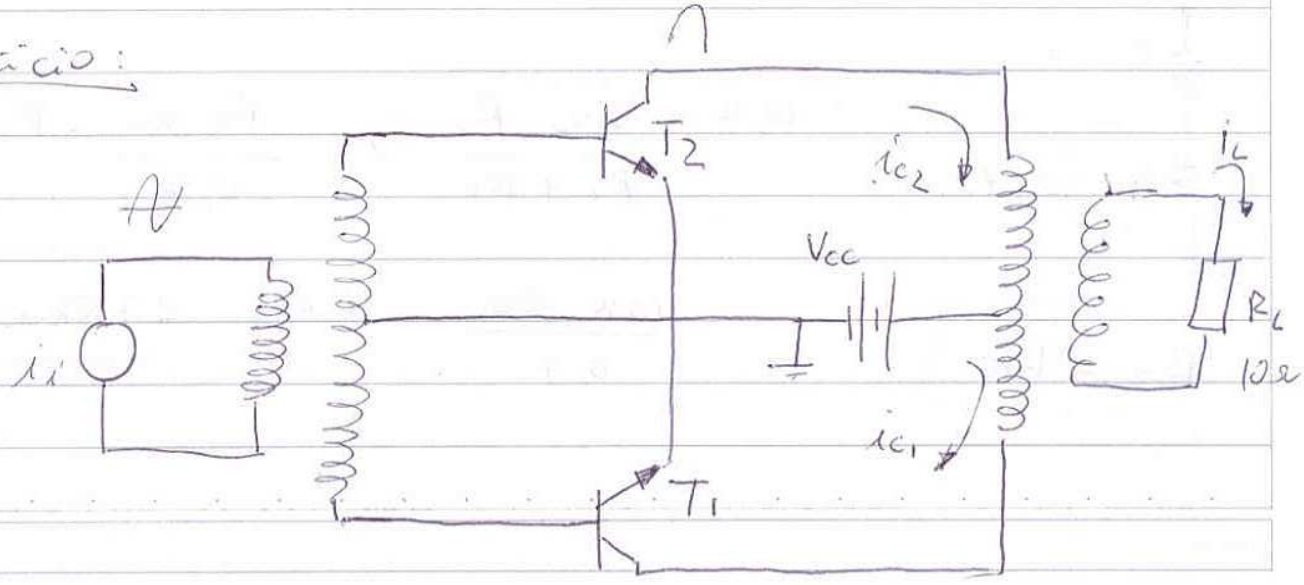
Pot Max en colector:

$$P_{c\,max} = 0,1 \frac{V_{cc}^2}{R'_L}$$

$$\eta_{max} = \frac{P_L}{P_{cc}} = 78,5\,\%$$

$$FM = \frac{P_{c\,max}}{P_{L\,max}} = \frac{1}{5}$$

Ejecución:



NOTA

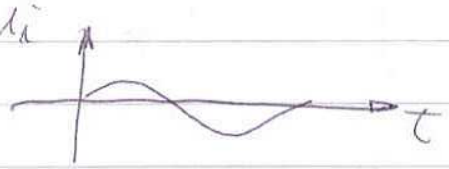
Datos: $R_L = 10\,\Omega$

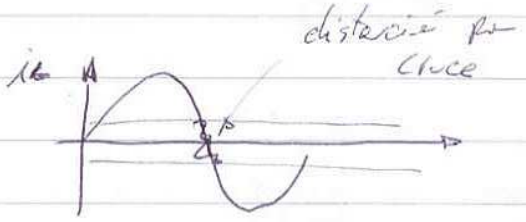
$P_{cmax} = 4\,W$

$\beta_{Vceo} = 40V$

$I_{CQ} = 1A$

Calcular: V_{cc}, N, red de polarización



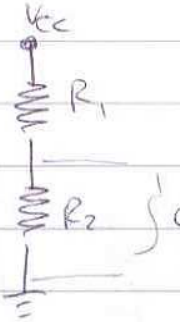


$$P_{Lmax} = \frac{P_{cmax}}{\eta_{FM}} = P_{cmax}\,5 = 4W \cdot 5 = \boxed{20W}$$

$$V_{cc} = \frac{\beta_{Vceo}}{2} = \frac{40V}{2} = 20V$$

$$I_{cmax} = \frac{V_{cc}}{R'_L} = \frac{V_{cc}}{N^2 R_L} = 2A$$

$$N^2 = \frac{V_{cc}}{I_{cm} R_L} = \frac{20V}{1A \cdot 10\,\Omega} = 2 \Rightarrow N = \sqrt{2}$$



$$0,7 = \frac{V_{cc} R_2}{R_2 + R_1} \Rightarrow \frac{R_2 V_{cc}}{0,7} - R_2 = R_1$$

$$\boxed{R_2 = 10K}$$

$$\frac{10K \cdot 20V}{0,7} - 10K = \boxed{275K\,\Omega = R_1}$$

NOTA