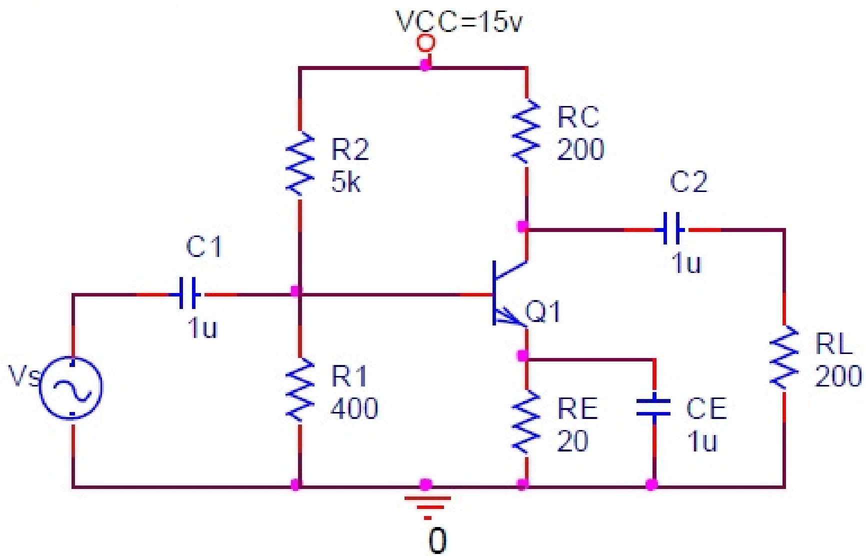
1. Para el siguiente amplificador (Valor: 2.5 unidades):



β=200.

Hallar: recta de carga DC, Av, Ai, Zin, Zout, Vomaxp, Vimaxp, PL, PDC y % de eficiencia del amplificador.

$$R_B = R_1 \parallel R_2 = 370\Omega$$

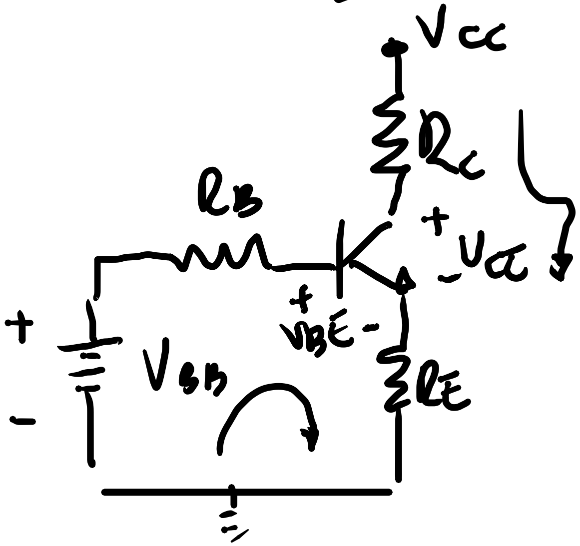
$$V_{BB} = \frac{V_{cc} R_1}{R_1 + R_2} = 1.1\,(V)$$

Análisis DC:

$\Rightarrow$ C $\rightarrow$ Abierto

$\Rightarrow$ V_{AC} $\rightarrow$ Cero

Modelo D.C



L.V.K en malla de entrada:

$$V_{BB} = \frac{I_c R_B}{\beta} + V_{BE} + I_c R_E$$

$$\Rightarrow I_{CQ} = \frac{V_{BB} - V_{BE}}{\frac{R_B}{\beta} + R_E} = 18.3\,mA$$

L.V.K en malla de salida:

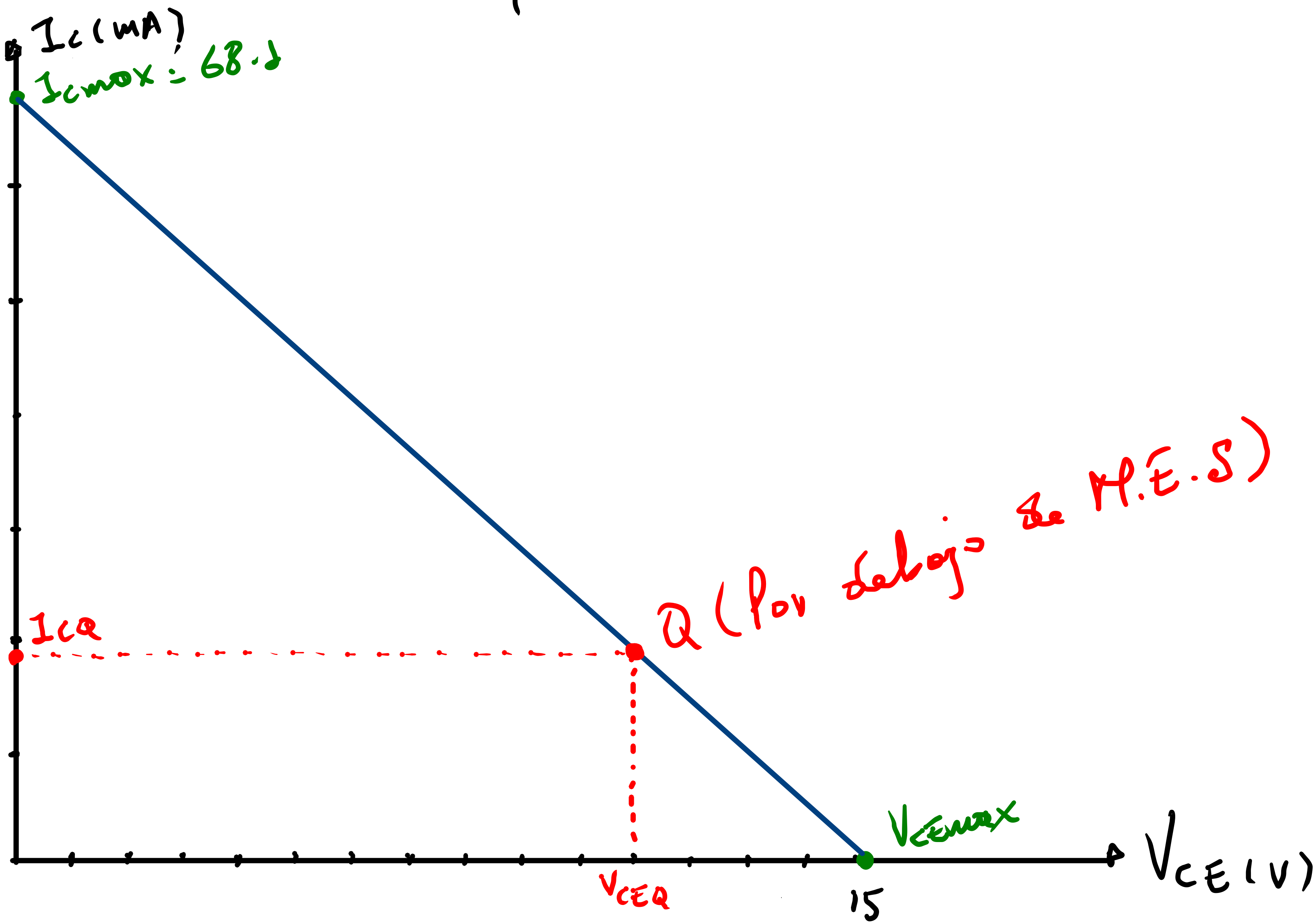
$$V_{cc} = I_c (R_c + R_E) + V_{CE}$$

$$\Rightarrow V_{CEQ} = V_{cc} - I_{CQ}(R_c + R_E) = 10.98 \approx 11\,(V)$$

$$I_{c\,max}\,(V_{CE}=0) = \frac{V_{CC}}{R_C+R_E} = 68.1\ mA$$

$$V_{CE\,max}\,(I_C=0) = V_{CC} = 15\,(V)$$

La recta DC queda:



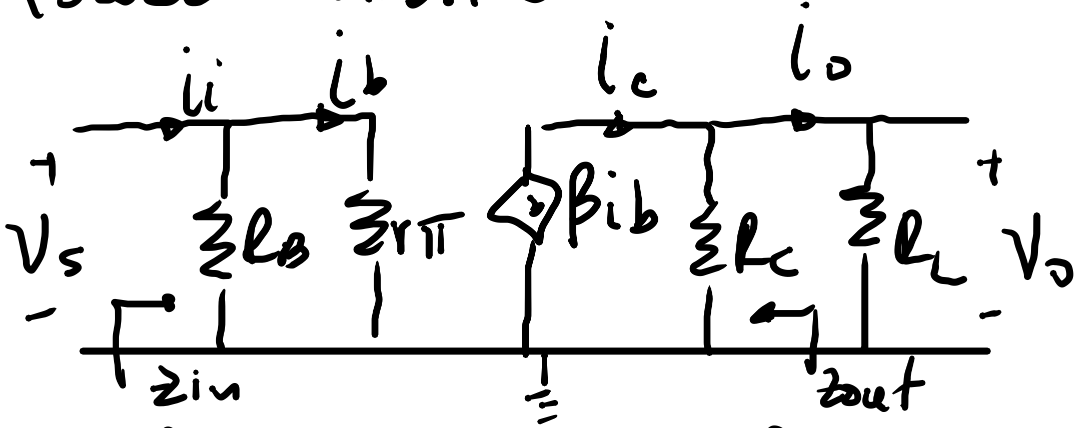
Análisis A.C $\Rightarrow$ C $\rightarrow$ corto

$V_{DC} \rightarrow$ Cero

$$r_\pi = \frac{\beta\, 26mV}{I_{CQ}} = 284\,\Omega$$

$$R_B = R_1 \| R_2 = 370\,\Omega$$

Modelo híbrido:



$$V_o = -\beta i_b R_C \| R_L$$

$$V_s = i_b r_\pi$$

$$\Rightarrow A_v = \frac{V_o}{V_s} = -\beta \frac{R_C \| R_L}{r_\pi} = \frac{-(200)(100)}{284} = -70.4$$

$$i_o = -\frac{\beta i_b R_C}{R_C + R_L} \; ; \quad i_b = \frac{i_i R_B}{R_B + r_\pi} \text{ , reemplazando:}$$

$$i_o = -\frac{\beta R_C}{R_C + R_L} \cdot \frac{i_i R_B}{R_B + r_\pi} \Rightarrow \frac{i_o}{i_i} = \frac{-\beta R_C R_B}{(R_C + R_L)(R_B + r_\pi)} = -56.6$$

$$Z_{in} = r_\pi \| R_B = 284 \| 370 = 160.7\,\Omega$$

$$Z_{out} = R_C = 200\,\Omega$$

$$v_{omax} = i_{omax} R_L \quad ; \quad i_{omax} = \frac{i_{cmax} R_C}{R_C + R_L}$$

$$i_{cmax} = I_{CQ} = 18.3\,mA \quad (\text{Caso II})$$

$$\Rightarrow v_{omax} = I_{CQ}(R_C \parallel R_L) = 1.83\,(V)$$

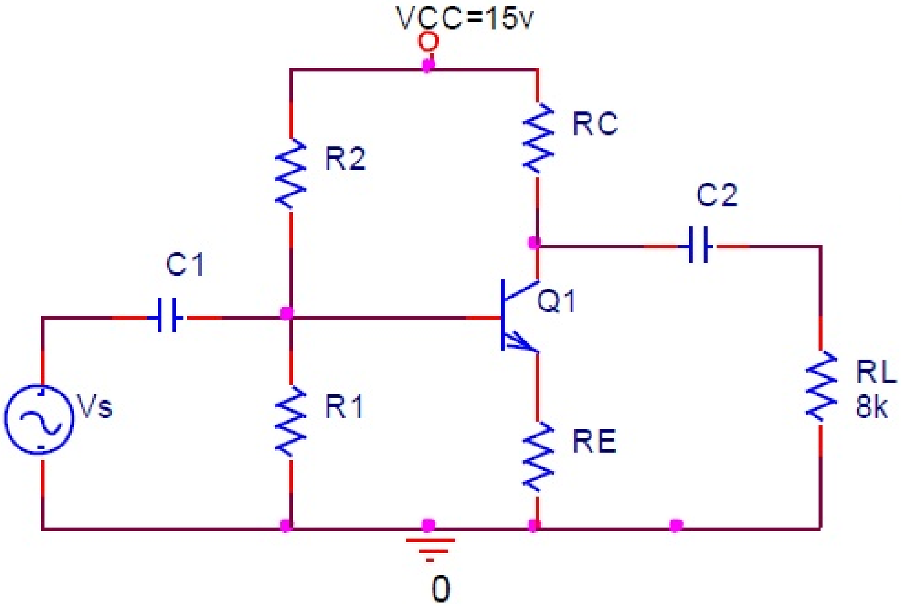
$$v_{imax} = \frac{v_{omax}}{|A_v|} = \frac{1.83}{70.4} \approx 26\,mV$$

$$P_L = \frac{v_{omax}^2}{2R_L} = \frac{(1.83)^2}{2(200)} = 8.37\,mW$$

$$P_{DC} = V_{CC} I_{CQ} = 15(18.3\,mA) = 274.5\,mW$$

$$\eta\% = \frac{P_L}{P_{DC}} \times 100\% = \frac{8.37}{274.5} \times 100\% = 3.05\%$$

2. Diseñar el siguiente amplificador EC para Av=-50, considerando máxima excursión simétrica (MES) (β=200, valor: 2.5 unidades):



$$R_1 = \frac{R_B}{1 - \frac{V_{BB}}{V_{CC}}}$$

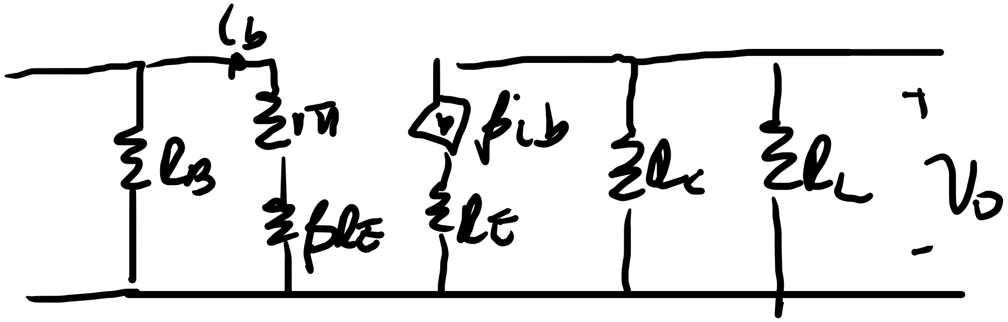
$$R_2 = \frac{R_B V_{CC}}{V_{BB}}$$

Por M.T.P:

$R_c = R_L = 8K$

Para R_E uso la ganancia Av

Modelo híbrido:



$$\frac{v_o}{v_i} = -\frac{\beta R_c \| R_L}{r\pi + \beta R_E}$$

Consideramos $r\pi <<< \beta R_E$

$$\Rightarrow A_v \approx -\frac{R_c \| R_L}{R_E} \Rightarrow R_E \approx \frac{-R_c \| R_L}{-50} \approx 80\,\Omega$$

Hallamos $I_{cq} = \dfrac{V_{cc}}{R_{DC} + R_{AC}}$; $R_{DC} = R_c + R_E = 8.08K$

$R_{AC} = (R_c \| R_L) + R_E = 4.08K$

$$I_{cq} = \frac{15}{8.08K + 4.04K} = 1.24\,mA$$

$$r\pi = \frac{\beta\,26mV}{I_{CQ}} = \frac{200(26)}{1.24} = 4.2K\Omega$$

$$r\pi <<< \beta R_E \Rightarrow 4.2K\Omega <<< 200(80) \;??$$

$$4.2K <<< 16K \quad \text{NO!!}$$

Se debe corregir R_E

$$R_E^* = R_E - \frac{r\pi}{\beta} = 80 - \frac{4.2K}{200} = 59\Omega.$$

$$R_B = 0.1\beta R_E^* = 0.1(200)(59) = 1.18K\Omega$$

Haciendo L.V.K en malla de entrada en DC:

$$V_{BB} = \frac{I_{CQ} R_B}{\beta} + V_{BE} + I_{CQ} R_E^* = 0.78(V)$$

$$R_1 = \frac{R_B}{1 - V_{BB}/V_{CC}} = \frac{1.18K\Omega}{1 - 0.78/15} = 1.24K\Omega$$

$$R_2 = \frac{R_B V_{CC}}{V_{BB}} = \frac{1.18K(15)}{0.78} = 22.7K\Omega.$$