Electrónica I - 2001-02 **Mini teste nº 2**
3º ano (LEEC - APEL) **30 NOV 01**

Resolução (compacta):

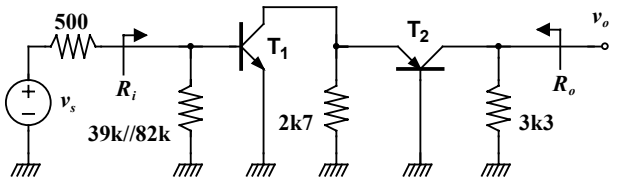
a) Para T_1: $\dfrac{39}{39+82}\times 12 = \dfrac{39\text{k} \,//\, 82\text{k}}{101} I_1 + 0{,}7 + 3\text{k}\, I_1 \;\Rightarrow\; I_1 = 0{,}97\,\text{mA}$

$V_{C1} = V_{E2} = 0{,}7\ \text{V} \;\Rightarrow\; I_1 + I_2 = \dfrac{6-0{,}7}{2\text{k}7} = 1{,}96\ \text{mA} \;\Rightarrow\; I_2 = 0{,}99\ \text{mA}$

$V_{E1} = -6 + 3\text{k}\ I_1 = -3{,}09\ \text{V} \;\Rightarrow\; V_{B1} = -2{,}39\ \text{V}$ e $V_{CE1} = 3{,}79\ \text{V}$

$V_{B2} = 0$ e $V_{C2} = -6 + 3\text{k}3\ I_2 = -2{,}73\ \text{V} \;\Rightarrow\; V_{EC2} = 3{,}43\ \text{V}$

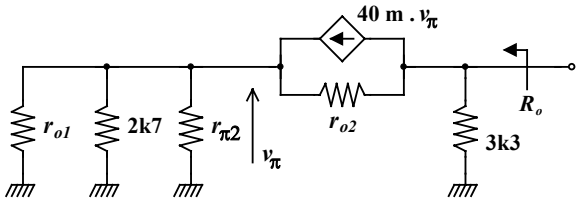
b) Esquema equivalente para pequenos sinais e médias frequências:



$R_i = 39\text{k} \,//\, 82\text{k} \,//\, r_{\pi 1}$

$r_{\pi 1} = \dfrac{\beta}{g_m} = \dfrac{100}{40\text{m}} = 2{,}5\ \text{k}\Omega \;\Rightarrow\; R_i = 2{,}28\ \text{k}\Omega$

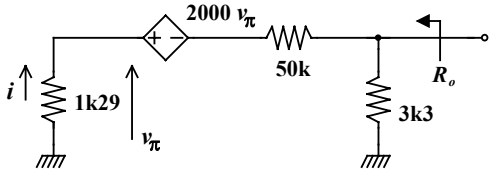
Seguramente $R_o \cong 3{,}3\ \text{k}\Omega$ pois a resistência de saída dum BC é muito elevada. De facto:



$g_m = 40\ \text{mA/V} \;\Rightarrow\; I_C = 1\ \text{mA}$

$r_{o1} = 150 / 1\text{m} = 150\ \text{k}\Omega$ e $r_{o2} = 50 / 1\text{m} = 50\ \text{k}\Omega$

$r_{\pi 2} = 100 / 40\text{m} = 2{,}5\ \text{k}\Omega \;\Rightarrow\; r_{o1} \,//\, 2\text{k}7 \,//\, r_{\pi 2} = 1{,}29\ \text{k}\Omega$



$v_\pi = 1\text{k}29\ i \;\Rightarrow\; 2000\ v_\pi = 2{,}57\text{M}\ i$

$R_o = 3\text{k}3 \,//\, (1\text{k}29 + 2{,}57\text{M} + 50\text{k}) \cong 3{,}3\ \text{k}\Omega$

c) $A_2 = \dfrac{v_o}{v_{e2}} = g_m\ 3\text{k}3$

$A_1 = \dfrac{v_{e2}}{v_{b1}} = -g_m\ (2\text{k}7 \,//\, r_{e2})$ e como $r_{e2} \cong \dfrac{1}{g_m} = 25\ \Omega \;\Rightarrow\; A_1 \cong -g_m\ r_e \cong -1$

$A_1\ A_2 \cong -g_m\ 3\text{k}3$

donde $A_v = \dfrac{v_o}{v_s} = A_1\ A_2\ \dfrac{R_i}{500 + R_i} \cong -108\ \text{V/V}$