

Resolução (compacta):

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

$V_{C1} = V_{E2} = 0,7 \text{ V} \Rightarrow I_1 + I_2 = \frac{6 - 0,7}{2k7} = 1,96 \text{ mA} \Rightarrow I_2 = 0,99 \text{ mA}$

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

$V_{B2} = 0$ e $V_{C2} = -6 + 3k3 I_2 = -2,73 \text{ V} \Rightarrow V_{EC2} = 3,43 \text{ V}$

b) Esquema equivalente para pequenos sinais e médias frequências:

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

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

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

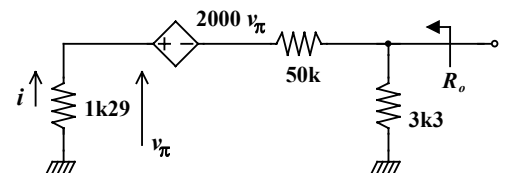
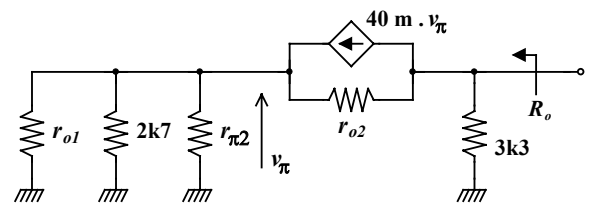
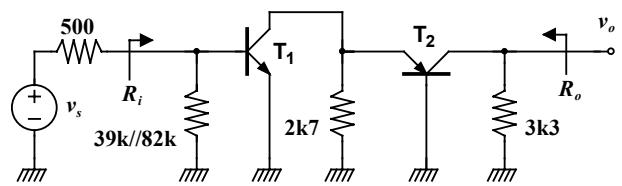
$g_m = 40 \text{ mA/V} \Rightarrow I_C = 1 \text{ mA}$

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

$r_{\pi 2} = 100 / 40\text{m} = 2,5 \text{ k}\Omega \Rightarrow r_{o1} // 2k7 // r_{\pi 2} = 1,29 \text{ k}\Omega$

$v_{\pi} = 1k29 i \Rightarrow 2000 v_{\pi} = 2,57\text{M} i$

$R_o = 3k3 // (1k29 + 2,57\text{M} + 50k) \cong 3,3 \text{ k}\Omega$



c) $A_2 = \frac{v_o}{v_{e2}} = g_m 3k3$

$A_1 = \frac{v_{e2}}{v_{b1}} = -g_m (2k7 // r_{e2})$ e como $r_{e2} \cong \frac{1}{g_m} = 25 \Omega \Rightarrow A_1 \cong -g_m r_e \cong -1$

$A_1 A_2 \cong -g_m 3k3$

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