1. The figure shows two common-emitter stages in cascade. It is given that $R_B = 1\, \text{k}\Omega$, $R_C = 10\, \text{k}\Omega$, $I_C = 1\, \text{mA}$, $V_{CE} = 10\, \text{V}$, $V_A = 40\, \text{V}$, $V_T = 25\, \text{mV}$, $\beta = 99$, $g_m = I_C/V_T$, $r_\pi = V_T/I_B$, $r_e = V_T/I_E$, and $r_0 = (V_A + V_{CE})/I_C$.

(a) What are the values of $g_m$, $r_\pi$, $r_0$, and $r_e$?

$$g_m = \frac{0.001}{0.025} = 0.04 \, \text{S} \quad r_\pi = \frac{0.025}{\frac{0.001}{99}} = 2475 \, \Omega \quad r_e = 25.25 \, \Omega \quad r_0 = 50\, \text{k}\Omega$$

(b) Draw the $\pi$ model for the two transistor circuit. You must use this circuit model to solve for the following three parts. Credit will not be given if any answers are written from memory without their derivation from the circuit.

(c) What is the value of $v_{b2}/v_i$?

$$\frac{v_{b2}}{v_i} = \frac{1}{R_B + r_\pi} \times (-\beta) \times r_0 || R_C \times r_\pi = -54.37$$

(d) What is the value of $v_o/v_{b2}$?

$$\frac{v_o}{v_{b2}} = \frac{1}{r_\pi} \times (-\beta) \times r_0 || R_C = -333.33$$

(e) What is the value of $v_o/v_i$?

$$\frac{v_o}{v_i} = \frac{v_{b2}}{v_i} \times \frac{v_0}{v_{b2}} = 1.812 \times 10^4$$