1. Use $|V_{BE}|=0.7$, $\beta=100$, $V_T=25\text{mV}$ ($V_{\text{sig}}$ is an AC source), ignore $r_o$.

The small-signal model circuit is shown below. It was found through a DC analysis that $I_{C1}=3\text{mA}$ and $I_{C2}=5\text{mA}$.

(a) Find a symbolic equation for the input resistance, $R_{\text{out}}$. (Include everything seen by the emitter node.)

(b) Find a symbolic expression for the midband overall gain, $\frac{V_o}{V_{\text{sig}}}$. Use only $R_{\text{sig}}, V_{\text{sig}}, R_1, R_2, R_3, R_4, R_5, R_E, r_{\pi1}, g_{m1}, r_{\pi2}, g_{m2}, \text{and } R_L$ in the expressions.

2. Assume the transistors below have a finite $\beta$ and an infinite Early voltage. Draw the small signal equivalent circuit (hybrid-$\pi$ or model T).

3. Using the circuit above from Problem 2, write an expression for the input resistance $R_{\text{in}}$ in the circuit shown. Your expression should include only real resistances ($R_1, R_2, R_3, R_4$, or a subset of these) and possibly $\beta$, $r_{e1}$ or $r_{\pi1}$, and $r_{e2}$ or $r_{\pi2}$. (Assume all transistors have the same $\beta$.) Circle your answer.
4. Use the circuit shown below for Problem 5. Assume all transistors are active and are the same and have a finite β and an infinite Early voltage. Draw the small signal equivalent circuit.

5. Write an expression for the input resistance $R_{\text{in}}$ in the circuit shown below. Your expression should include only real resistances ($R_1, R_2, R_3, R_4, R_5, R_6, R_{G1}, R_{G2}$ or a subset of these) and possibly β, $r_e$, or $r_\pi$.

Use the circuit below for the following 3 problems. Use $|V_{BE}|=0.7$, $\beta=100$, $V_T=25\text{mV}$ ($V_s$ is an ac source), ignore $r_o$.

6. Find $R_{\text{in}}$ for the circuit.
7. Find $R_{\text{out}}$ for the circuit.
8. Find the gain $V_o/V_{\text{sig}}$.