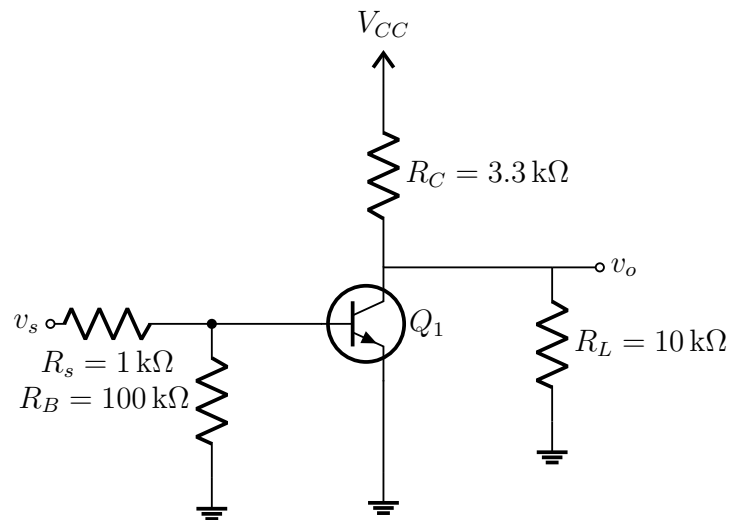


For all questions, use the midband hybrid- π model. Treat coupling and bypass capacitors as shorts, DC supplies as AC ground, and neglect r_o .

Problem 1

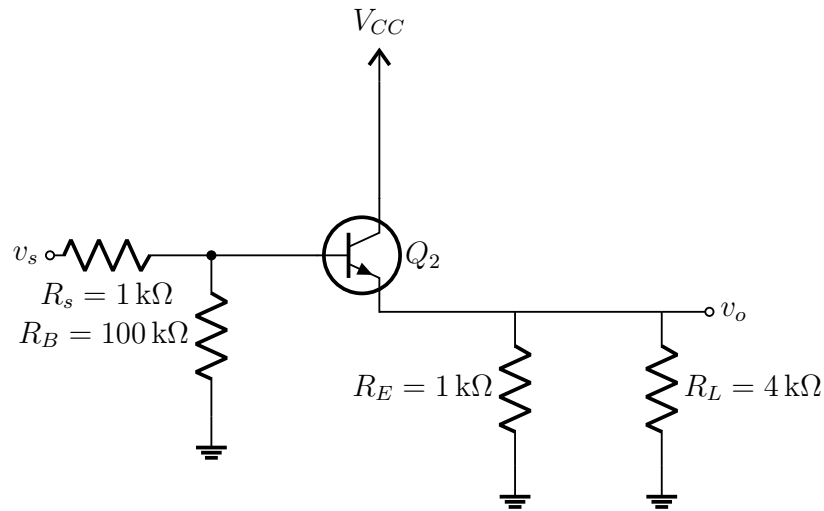
For the circuit below, $\beta = 100$, $g_m = 40 \text{ mS}$, $R_C = 3.3 \text{ k}\Omega$, $R_L = 10 \text{ k}\Omega$, $R_B = 100 \text{ k}\Omega$, and $R_s = 1 \text{ k}\Omega$. The emitter is at AC ground. Find the input resistance R_i looking into the base network, the voltage gain $A_v = v_o/v_s$, and the output resistance R_o with R_L disconnected. Draw the hybrid- π model used in your analysis.



Final Answer: $R_i \approx 2.44 \text{ k}\Omega$, $A_v \approx -70.4$, $R_o = 3.3 \text{ k}\Omega$.

Problem 2

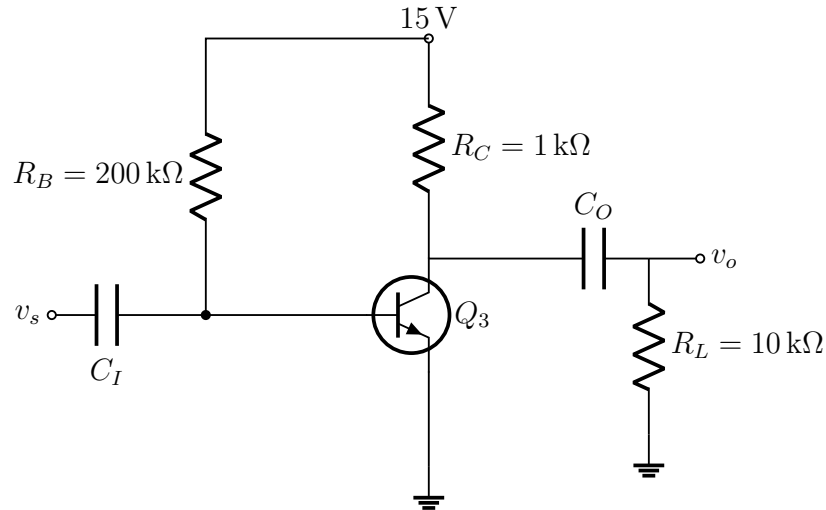
For the emitter follower below, $\beta = 100$, $g_m = 40 \text{ mS}$, $R_B = 100 \text{ k}\Omega$, $R_s = 1 \text{ k}\Omega$, $R_E = 1 \text{ k}\Omega$, and $R_L = 4 \text{ k}\Omega$. Find the input resistance R_i seen by the source after R_s , the voltage gain $A_v = v_o/v_s$, and the output resistance R_o with R_L disconnected. Draw the hybrid- π model and show the test source used to find R_o .



Final Answer: $R_i \approx 45.4 \text{ k}\Omega$, $A_v \approx 0.949$, $R_o \approx 33.4 \Omega$.

Problem 3

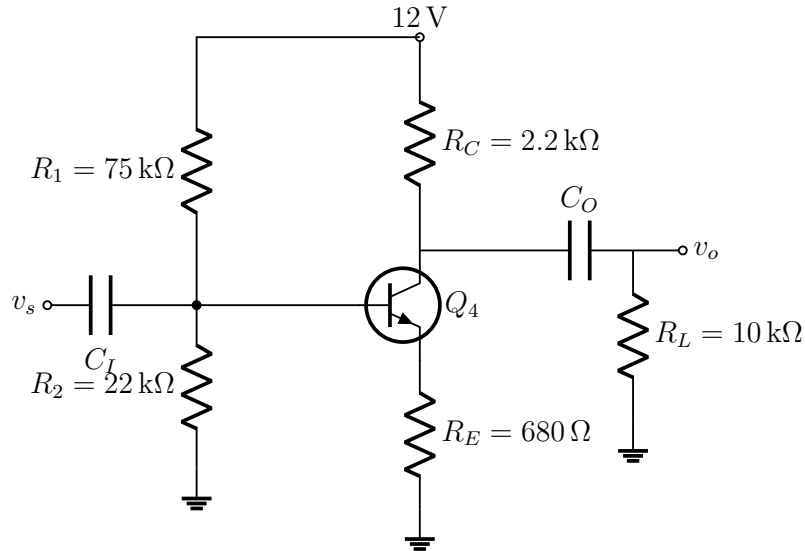
For the circuit below, $V_{CC} = 15\text{ V}$, $R_B = 200\text{ k}\Omega$, $R_C = 1\text{ k}\Omega$, $R_L = 10\text{ k}\Omega$, and $\beta = 100$. Take $V_{BE} = 0.7\text{ V}$ and $V_T = 25\text{ mV}$. Find the DC collector current I_C , the input resistance R_i , the midband gain $A_v = v_o/v_s$, and the output resistance R_o with R_L disconnected.



Final Answer: $I_C \approx 7.15\text{ mA}$, $R_i \approx 349\text{ }\Omega$, $A_v \approx -260$, $R_o = 1\text{ k}\Omega$.

Problem 4

For the circuit below, $V_{CC} = 12\text{ V}$, $R_1 = 75\text{ k}\Omega$, $R_2 = 22\text{ k}\Omega$, $R_C = 2.2\text{ k}\Omega$, $R_E = 680\text{ }\Omega$, $R_L = 10\text{ k}\Omega$, and $\beta = 100$. The emitter resistor is not bypassed. Take $V_{BE} = 0.7\text{ V}$ and $V_T = 25\text{ mV}$. Find I_C , R_i , $A_v = v_o/v_s$, and R_o with R_L disconnected.



Final Answer: $I_C \approx 2.36\text{ mA}$, $R_i \approx 13.7\text{ k}\Omega$, $A_v \approx -2.59$, $R_o = 2.2\text{ k}\Omega$.

Problem 5

In the circuit of Fig. 5-31, $V_{CC} = 12\text{ V}$, $R_C = 3\text{ k}\Omega$, $R_{F1} = 120\text{ k}\Omega$, $R_{F2} = 68\text{ k}\Omega$, and $\beta = 140$. Take $V_{BE} = 0.7\text{ V}$ and $V_T = 25\text{ mV}$. Find the input resistance R_i , output resistance R_o , and midband voltage gain $A_v = v_o/v_i$. Include the effect of the capacitor from the feedback-network midpoint to ground.

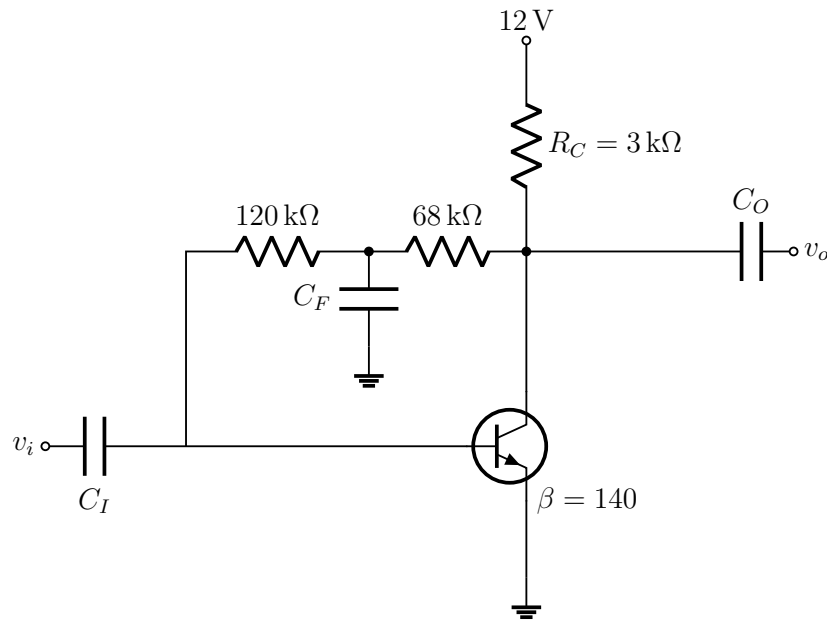


Fig. 5-31

Final Answer: $R_i \approx 1.34\text{ k}\Omega$, $R_o \approx 2.87\text{ k}\Omega$, $A_v \approx -298$.

Problem 6

In the circuit of Fig. 5-32, $V_{CC} = 9\text{ V}$, the two divider resistors are $20\text{ k}\Omega$ each, the base-series resistor and source resistance are $10\text{ k}\Omega$ each, and $R_E = 2\text{ k}\Omega$. Let the transistor have current gain β and small-signal parameters g_m and r_π . Find R_i , R_o , and $A_v = v_o/v_s$ at midband in terms of these parameters. Explain the role of C_1 in the AC equivalent circuit.

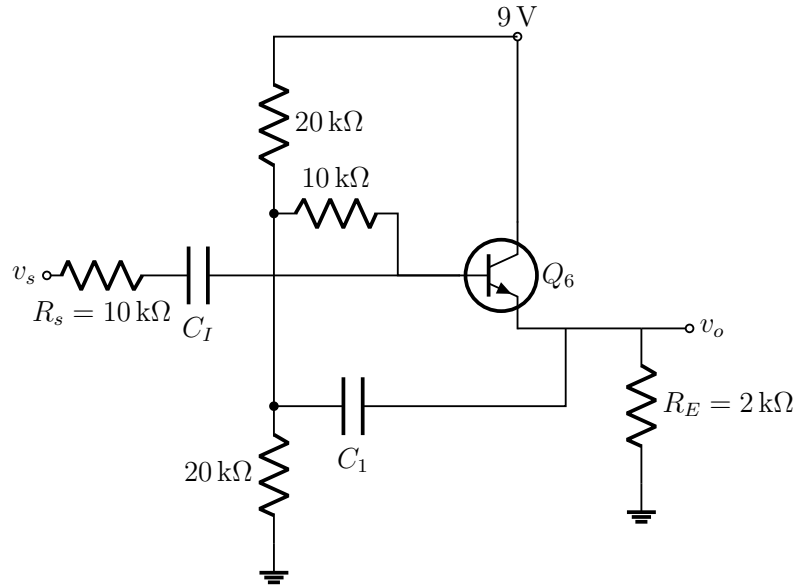


Fig. 5-32

Final Answer: At midband, let $R = r_\pi \parallel 10\text{ k}\Omega$ and $R'_L = 2\text{ k}\Omega \parallel 20\text{ k}\Omega \parallel 20\text{ k}\Omega$. Then $R_i = R + (1 + g_m R)R'_L$, $A_v = \frac{R_i}{R_i + 10\text{ k}\Omega} \frac{(1 + g_m R)R'_L}{R_i}$, and $R_o = R'_L \parallel \frac{10\text{ k}\Omega + R}{1 + g_m R}$.