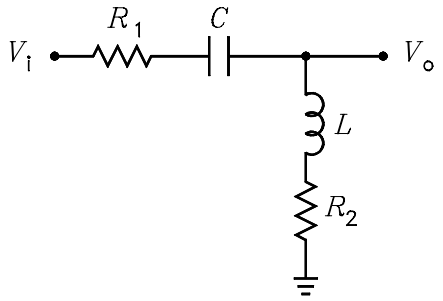
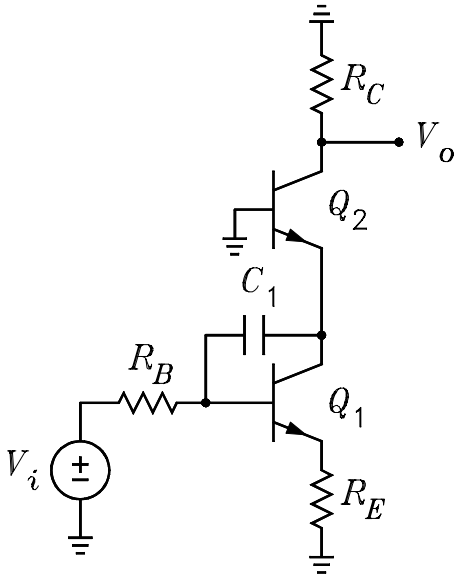
EE3050 Fall 2000
Some Practice Problems

1. Solve for V_o/V_i for the circuit shown. Put it into the standard form with a resonance frequency ω_0 and quality factor Q, and give the equations for each. What condition on the elements in the circuit makes the poles of the transfer function complex? Sketch the Bode magnitude and phase plots if $Q = 2$. Label the slopes and asymptotic values.

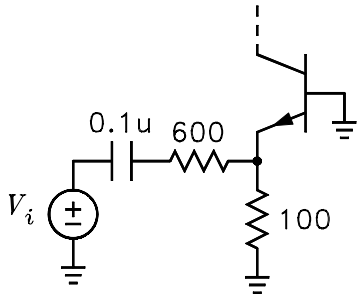


2. The figure shows the ac signal circuit of a cascode amplifier. It is given that $\beta = 199$, $r_x = 20$, $V_T = 0.025$, $r_0 = \infty$, $I_{E1} = 1$ mA, $C_2 = 100$ pF, $R_B = 1$ kΩ, $R_E = 20$ Ω, and $R_C = 10$ kΩ. What is the low-frequency gain of the amplifier? What is K in applying the Miller theorem to C_1? What is the time constant for the base circuit of Q_1? What is the time constant for the collector circuit of Q_1? What is the approximate upper cutoff frequency of the amplifier? Repeat the problem with Q_2 removed and R_C connected to the collector of Q_1. Calculate the percentage changes in the low-frequency gain and in the bandwidth.

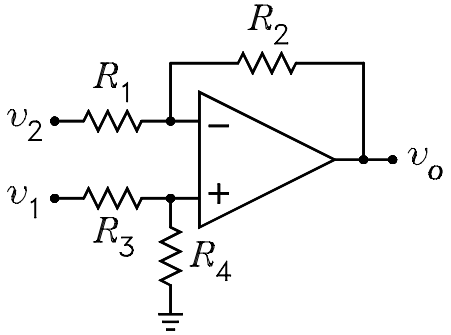


3. For the oscillator problem in problem 5 of assignment 5, sketch the output voltage waveforms of the two op amps when the circuit operates as an oscillator. Assume that the relative phase of the output voltage from the upper op amp is 0^o. What is the phase difference between the two outputs? What is the amplitude difference?

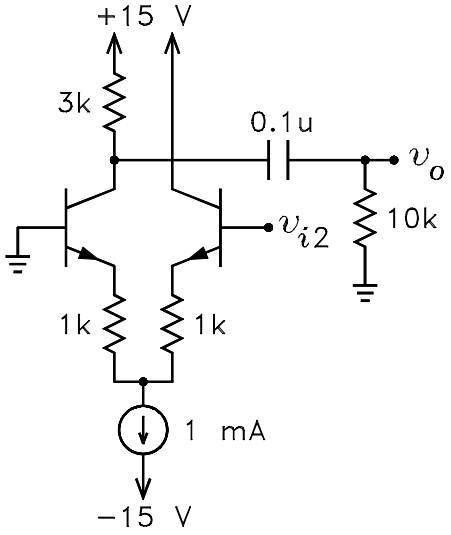
4. The BJT shown is biased at $I_E = 2$ mA. If $\beta = 199$, $r_0 = \infty$, and $r_x = 20\ \Omega$, solve for the time constant and pole frequency for the 0.1 μF capacitor. What is the transfer function that accounts for the effect of the capacitor on the gain of the circuit?



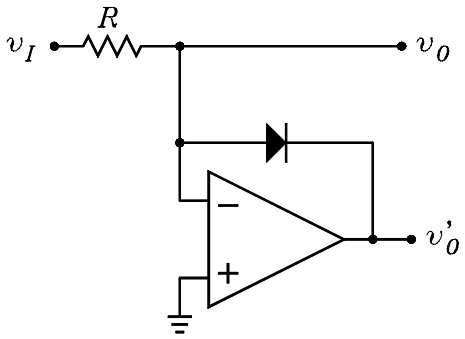
5. Use superposition of v_1 and v_2 to solve for v_o. What is the condition on the resistors for $v_o = A\,(v_1 - v_2)$ and what is the equation for A?



6. Each BJT has the parameters $\beta = 199$, $r_x = 20\ \Omega$, $r_0 = 30$ kΩ, and $V_T = 0.025$ V. Solve for the time constant for the 0.1 μF capacitor and the pole frequency. What is the transfer function that accounts for the effect of the capacitor on the gain of the circuit?



7. For v_I a triangle wave, sketch the waveforms for v_O and v_O'. Can you modify the circuit so that the waveform for v_O is unchanged but the op amp does not saturate? Do not assume ideal diodes.



8. The figure shows a MOSFET amplifier. It is given that $R_1 = 50\ \Omega$, $C_1 = 0.1\ \mu$F, $C_2 = 10$ pF, $r_0 = 20\ \text{k}\Omega$, $\chi = 0.4$, and $g_m = 1/250$. Solve for the transfer function for the effect of each capacitor on the voltage gain of the circuit.