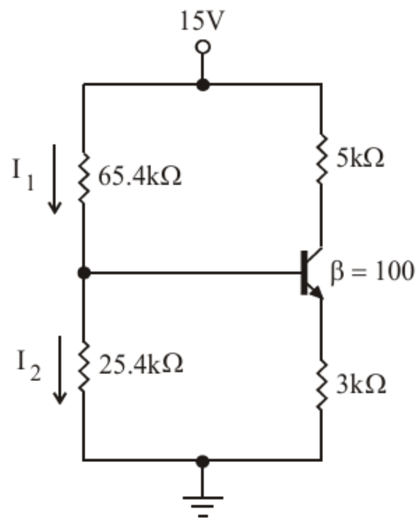
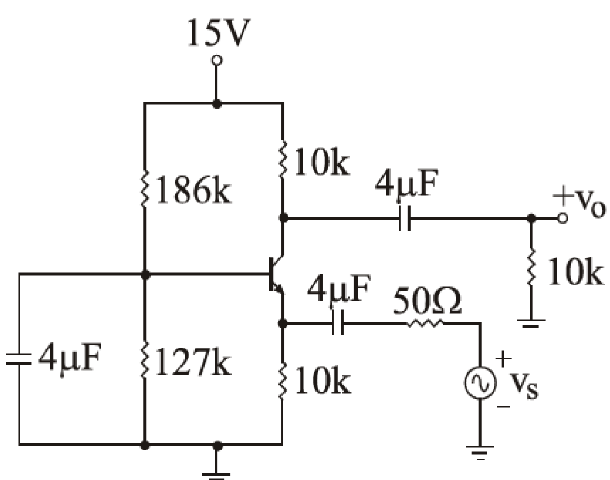
Problem set 2

1. For the circuit shown below, find I_1, I_2, I_C, I_E, g_m and r_π.



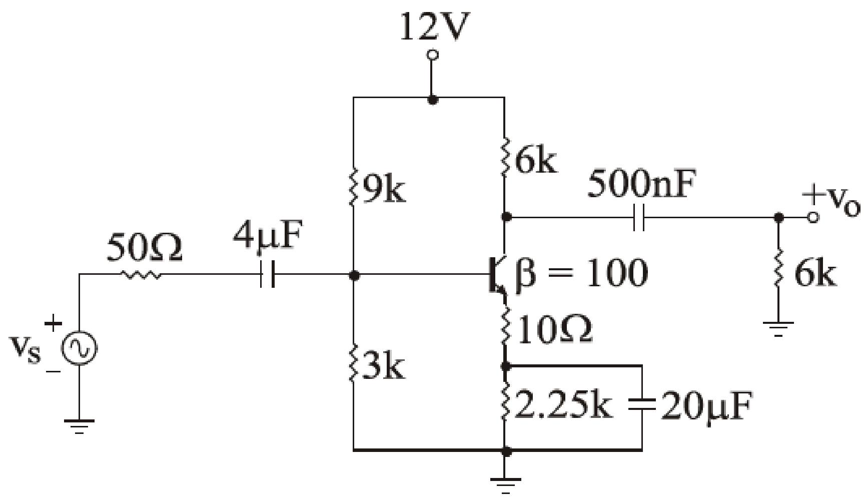
2. For the circuit below, find A_M, ω_{3dbL} and ω_{3dBH}, given that β=100 and the hybrid-π model has the parameters c_π=10pF, c_μ=2pF and r_o=∞.



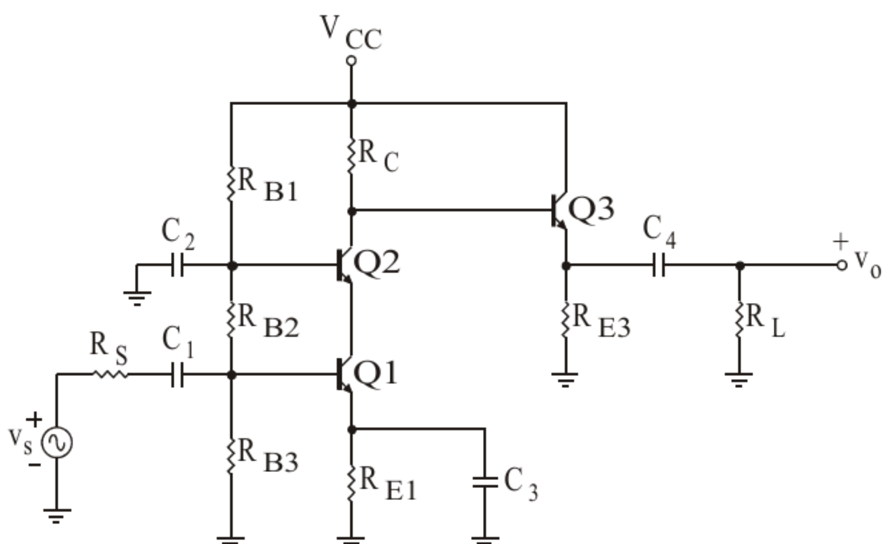
3. For the circuit below:

3a. draw the low-frequency circuit, the mid-band circuit and the high-frequency circuit

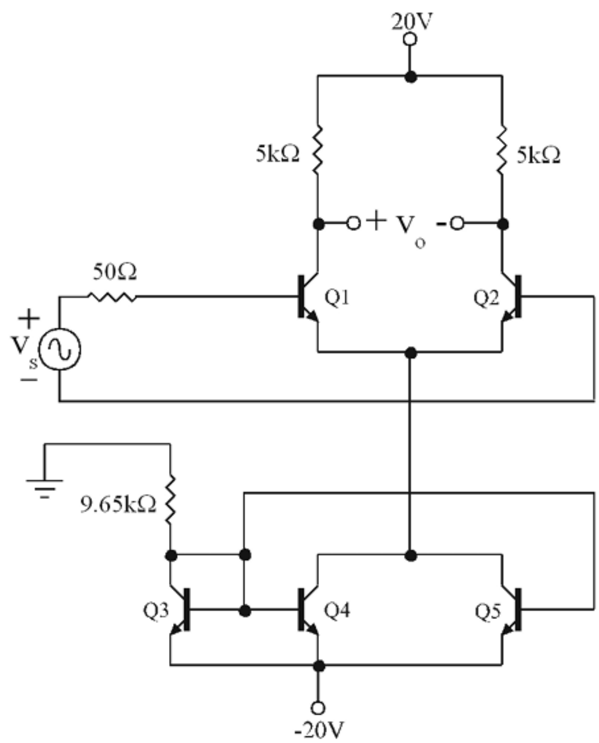
3b. derive the mid-band gain A_M and $F_L(s)$



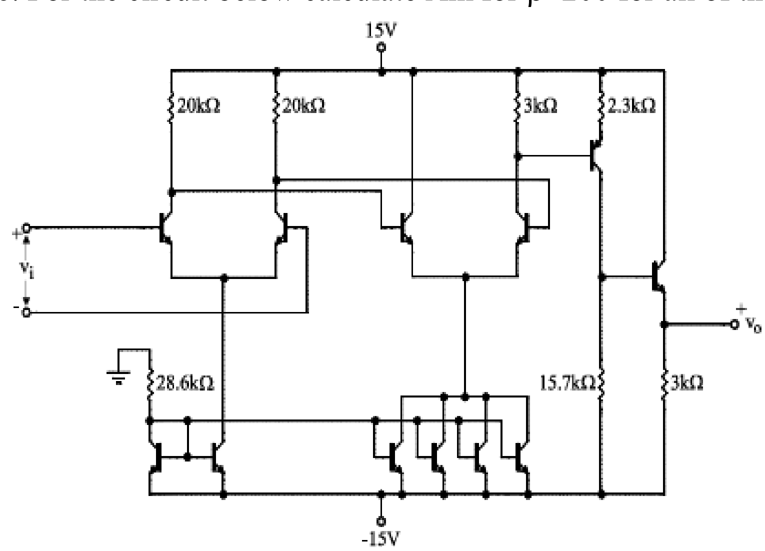
4. For the circuit below, do the following:
a. Draw the high-frequency small-signal model
b. Show that vp1=vp2 at mid-band, irrespective of whether b1=b2 or not
c. find the expressions for the three high-frequency poles. Which one do you think will be the dominant pole.



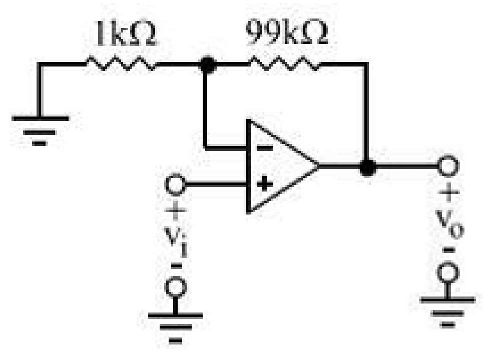
5. Assuming that the differential amplifier shown below is attached to a load consisting of a 10kΩ resistor in parallel with a 100pF capacitor, find the value of the mid-band gain and the high-frequency 3dB point (A: A_M=-196V/V, ω_{3dbH}=1.98x10^6rad/s)



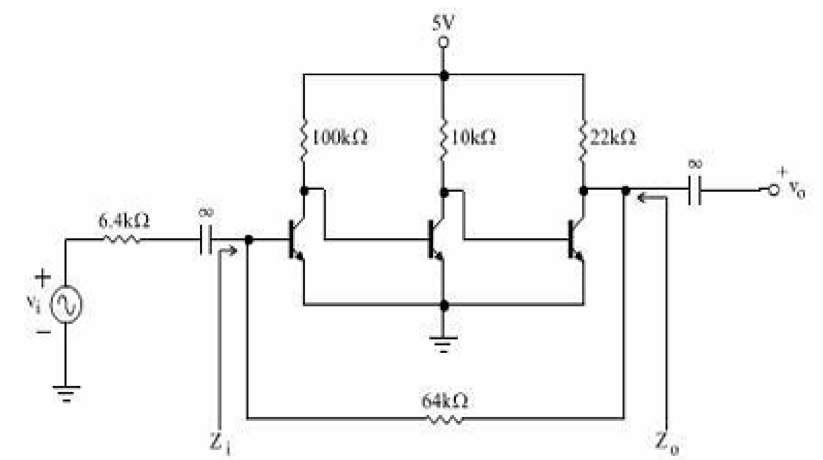
6. For the circuit below calculate Am for β=200 for all of the transistors



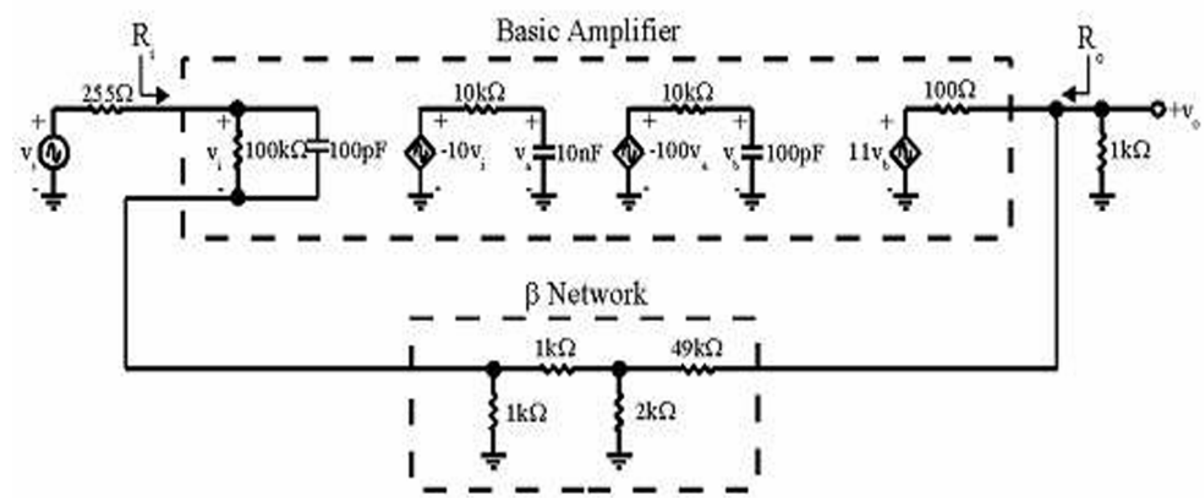
7. The op-amp shown below has an open-loop gain of 10^5 and a bandwidth of 10Hz (single-pole transfer function approximation). Use feedback techniques to calculate the gain and bandwidth of the circuit. What would the gain and bandwidth be if the open-loop gain of the op-amp was $5x10^4$ instead of 10^5?



8. For the circuit below, calculate A_M, Z_i, and Z_o, all at mid-band



9. For the circuit below use feedback techniques to find the mid-band gain $A_M = v_o/v_s$, the gain margin (GM), the phase margin ($PM = \varphi_1 - \varphi_{180}$), the input resistance R_i and the output resistance R_o of the amplifier (Hint: use the series-shunt feedback topology).



10. For the circuit below find the loop gain L(s), the frequency of oscillation and R_2/R_1 for oscillation. Assume the op-amp to be ideal.