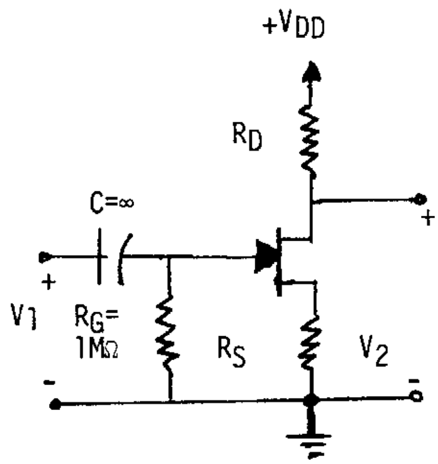
FEEDBACK AMPLIFIER PROBLEMS

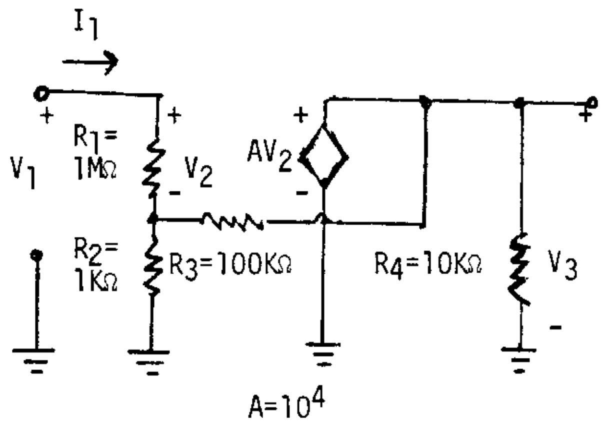
1.) Use the concepts of negative feedback to design R_D and R_S so that if g_m varies by $\pm$ 50% that the voltage gain, V_2/V_1, is equal to -10 $\pm$ 10%. The nominal value of $g_m = 2 \times 10^{-3}$ mhos and r_d is infinite.
(Answer: R_D = 25 kilohms and R_S = 2 kilohms)



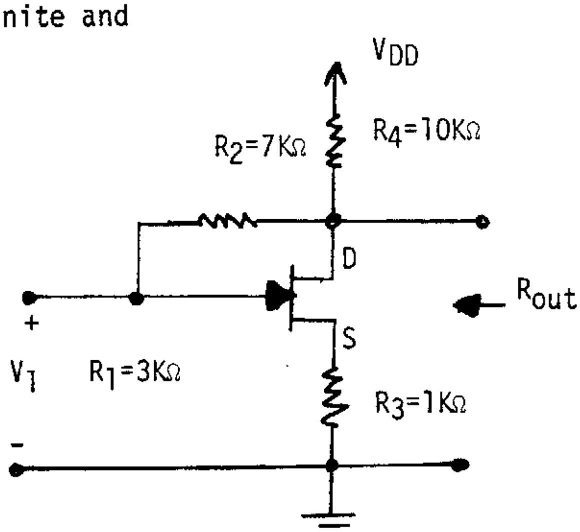
2.) A single-loop feedback circuit is shown. Solve for the input resistance defined as

$R_{in} = V_1/I_1$

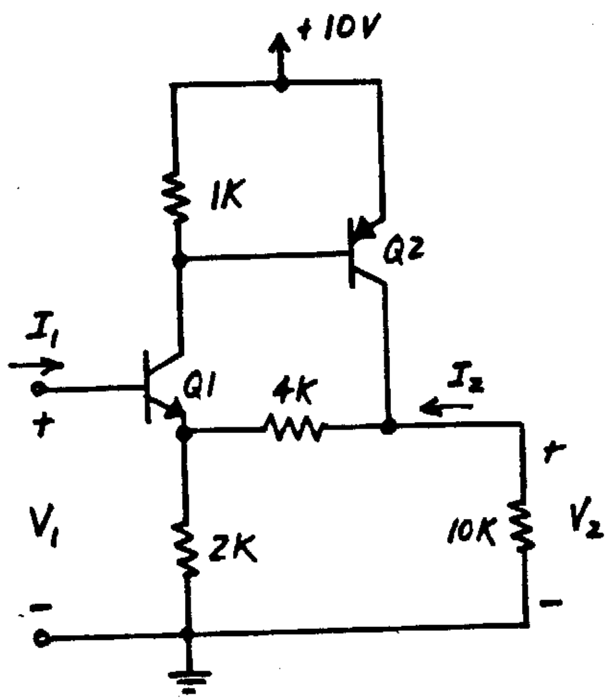
for the element values shown.
(Answer: $R_{in} \cong 10^9$ ohms)



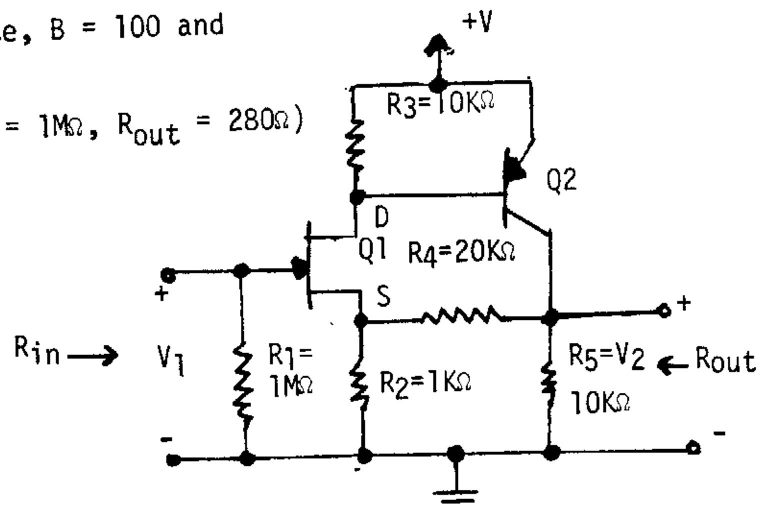
3.) Find the output impedance of the circuit shown where this impedance is designated as R_{out}. Assume that r_d is infinite and that $g_m = 5 \times 10^{-3}$ mhos.
(Answer: R_{out} = 2.22 kilohms)



4.) A negative feedback circuit is shown below. Use the techniques of feedback analysis to analyze this circuit and find the voltage gain, V_2/V_1, the current gain, I_2/I_1, the input resistance, V_1/I_1, and the output resistance, V_2/I_2. Assume that r_{π} ie = 1K and B = 100 for both transistors. Ignore r_o and r_u.
(Answer: $\frac{V_2}{V_1} = 2.94$, $\frac{I_2}{I_1} = -1874$, $\frac{V_1}{I_1} = 6.376$ MΩ, $\frac{V_2}{I_2} = 80.43Ω$)



5.) Use the methods of opening the feedback loop to find R_{in}, V_2/V_1, and R_{out} of the circuit shown. Assume the g_m = $3X10^{-3}$ mhos, r_d is infinite, B = 100 and r_{π} = 1000 ohms.
(Answer: $\frac{V_2}{V_1} = 20.12$, R_{in} = 1MΩ, R_{out} = 280Ω)



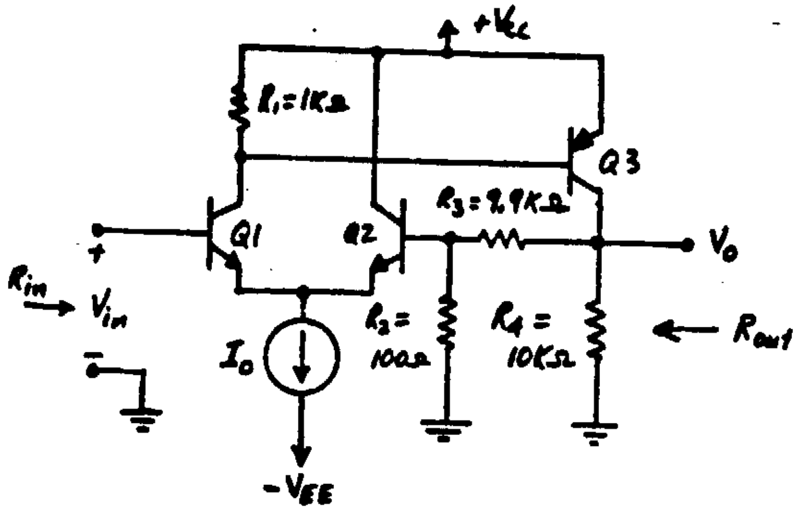
6.) A feedback amplifier using BJT's is shown below.

a.) What type of single loop feedback topology is this circuit? Identify the variables X_s, X_f, X_k, and X_0 with regard to their location in the circuit and whether they are voltages or currents. (Answer: voltage series)

b.) Assume that the open loop gain is much greater than unity and find an approximate value for V_o/V_{in}. (Answer: 100)

c.) Calculate the voltage gain, V_o/V_{in}, using the methods of opening the feedback loop and calculating A and B. Do not assume that the loop gain is greater than unity. (Answer: 79.67)

d.) Calculate R_{in} and R_{out} of this circuit. (Answer: R_{in}=63.98 KΩ, R_{out}=164Ω)

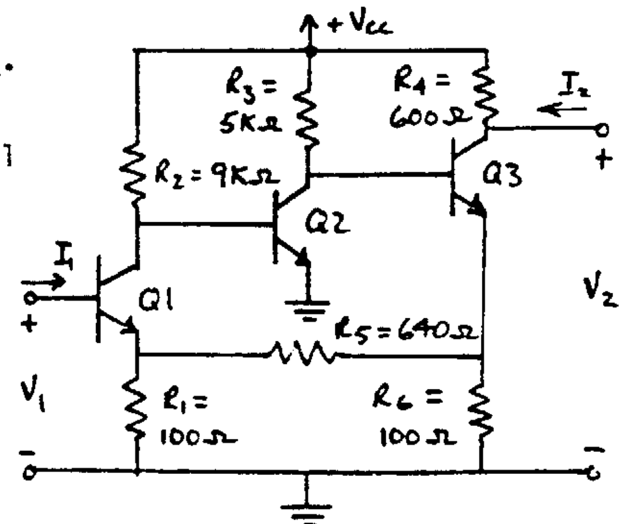


(Answer: $r_{\pi}1=r_{\pi}2=r_{\pi}3$ = 1KΩ $B_1=B_2=B_3$ = 50)

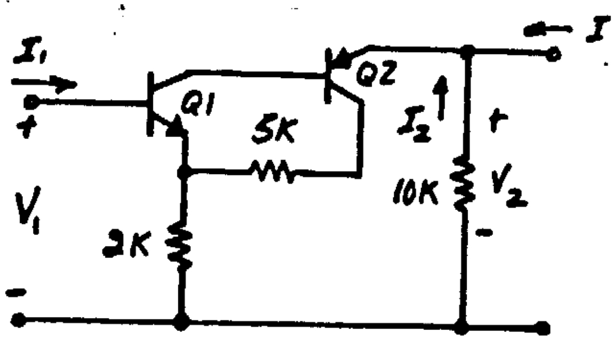
7.) Use the concepts of feedback analysis to find V_2/V_1, $V_1/I_1=R_{in}$, and $V_2/I_2=R_{out}$. Do not assume that the open loop gain is much greater than unity. Assume that all transistors are identical with B=100 and $r_o=r_u=\infty$ and I_{C1}=0.6mA, I_{C2}=1mA, and I_{C3}=4mA.

(Answer: $\frac{V_2}{V_1}$ = 50,21, R_{in}=3.187MΩ,

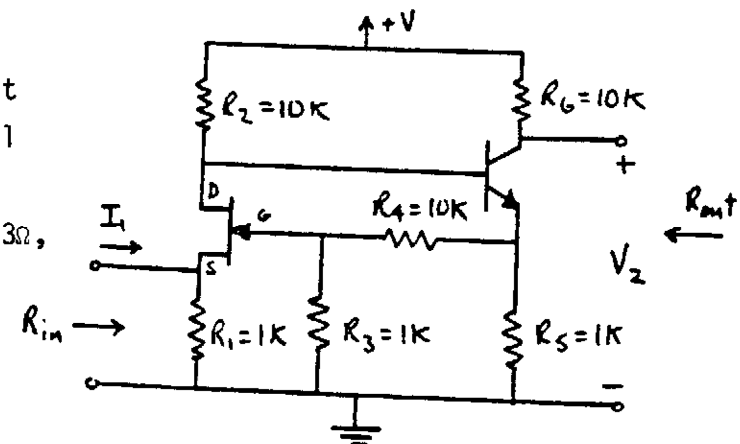
R_{out} = 600Ω)



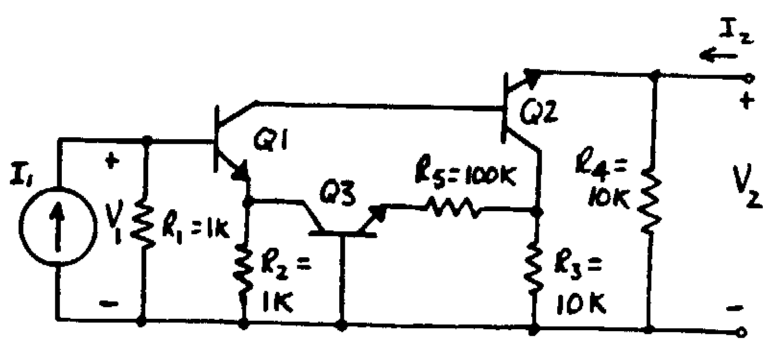
8.) A two stage feedback circuit is shown below. Assume that both transistors are identical and have a B=100 and an r_π =1000 ohms. Use the methods of feedback analysis to find B, A_f, $R_{in}=V_1/I_1$, $R_{out}=V2/I$, and V_2/V_1.
(Answer: A=0.04975 mhos, B=2KΩ, $A_f=4.95 \times 10^{-4}$ mhos, R_0=10K, $\frac{V_2}{V_1}$= -4.9, R_{in} = 20MΩ)



9.) A feedback circuit is shown. Do not assume that the loop gain is much greater than unity. Find V_2/I_1, R_{in}, and R_{out}. Assume that r_π = 1000 ohms, B = 100, g_m = .001 mhos, and $r_d \approx \infty$.
(Answer: $\frac{V_2}{I_1}$ = -34,400Ω, R_{in} = 643Ω,
R_{out} = 10KΩ)

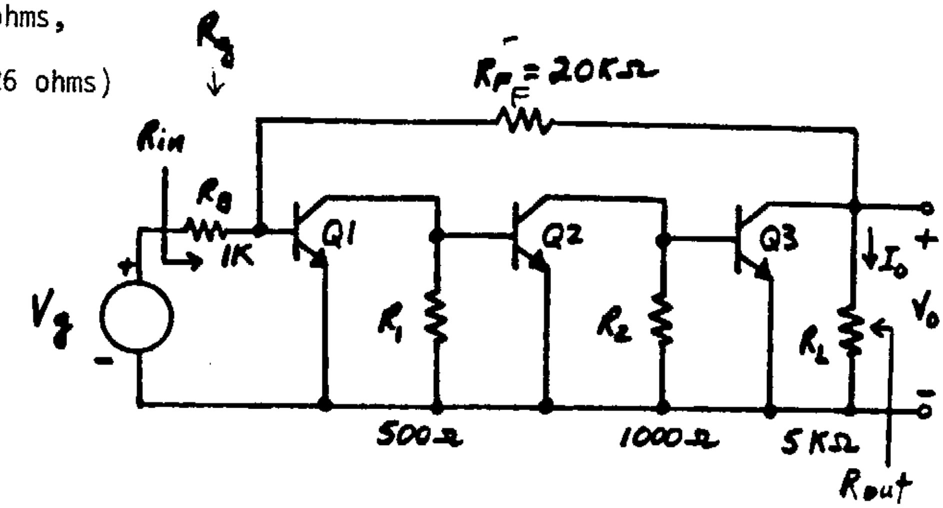


10.) A feedback circuit is shown. Do not assume that the loop gain is much greater than unity. Find V_2/V_1, $R_{in}=V_1/I_1$, and $R_{out}=V_2/I_2$. Assume all transistors are identical and have B = 100 and r_π = 1000 ohms. (Answer: $\frac{V_2}{V_1}$ = 100.79, $R_{in} \cong$ 1KΩ, R_{out} = 10KΩ)



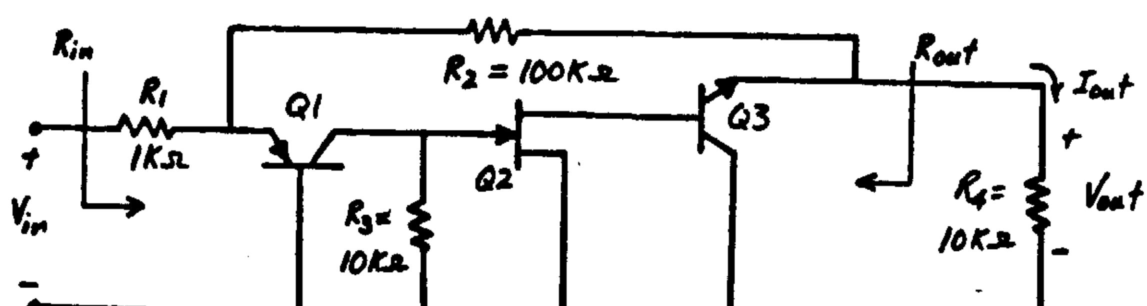
11.) For the feedback network shown find V_o/V_g, R_{in}, and R_{out}. Assume that $r_{\pi 1}=r_{\pi 2}=r_{\pi 3}=$ 1000 ohms and $B_1=B_2=B_3=100$.

(Answer: $\frac{V_o}{V_g}= -20.0$, $R_{in}=$ 1000.03 ohms, R_{out}-0.126 ohms)



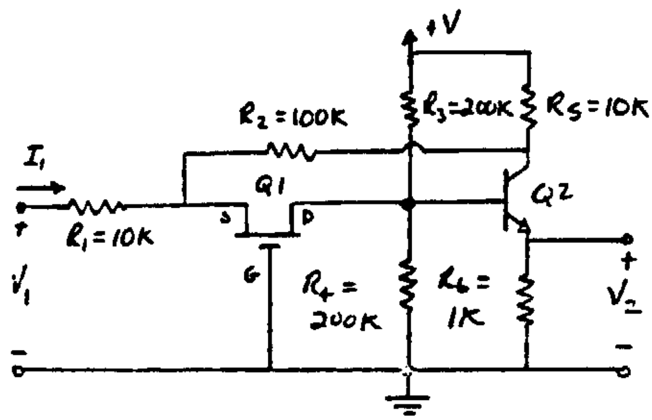
12.) A single loop negative feedback circuit is shown. Assume that B=100, r_π=1000 ohms, and that $r_u=r_o=0$ for all BJT's and that $g_m=1\times10^{-3}$ mhos and rd is infinite for the JFET. Do not assume that the loop gain is much greater than one. Use the methods of opening the feedback loop and identify X_s, X_i, X_f, and X_o; find values for A and B; and solve for V_{out}/V_{in}, R_{in}, and R_{out}.

(Answer: A=9.09 X 10^6 ohms, B= -10^{-5} mhos, $\frac{V_{out}}{V_{in}}$= 98.912, R_{in} =1000.1 ohms, R_{out}= 98.87 ohms)



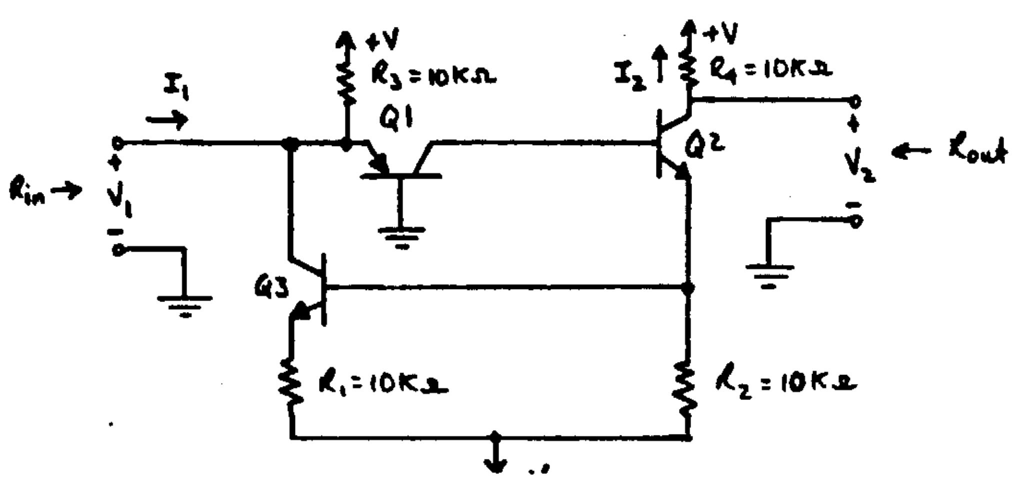
13.) A negative feedback circuit is shown. Do not assume that the loop gain is greater than one and use the methods of opening the loop to calculate a value of V_2/V_1 and $R_{in}=V_1/I_1$. Assume that B=100, r_π=1000 ohms, $g_m=10^{-3}$ mhos, and r_{ds}= infinity.

(Answer: $\frac{V_2}{V_1}$= 5.025, R_{in} = 10.187 ohms)



14.) The negative feedback amplifier shown has the current-shunt topology. Do not assume that Aβ>1 and use the methods of opening the feedback network to calculate A and β and numerically evaluate V_2/V_1, R_{in}, and R_{out}. Assume both transistors are identical and have B=100 and r_π = 1000 ohms.

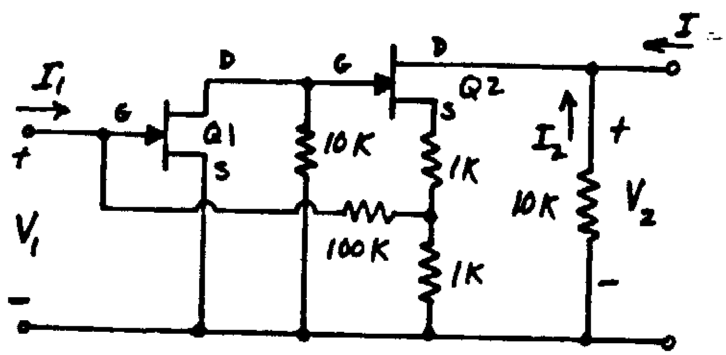
(Answer: $\frac{V_2}{V_1}$ = 1.0007 X 10^5, R_{in} = 0.1 ohms, R_{out} = 10K ohms)



15.) A two stage feedback circuit is shown below. Assume that both JFET's are identical and have a $g_m=10^{-3}$ mhos and $r_d = \infty$. Use the methods of feedback analysis to find A, β, A_f, $R_{in}=V_1/I_1$, $R_{out}=V_2/I$, & V_2/V_1.

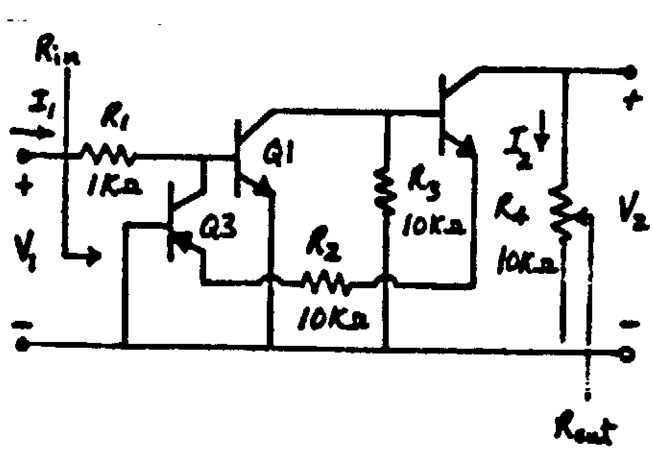
(Answer: $A = -334$, $B = -\frac{1}{101}$, $A_f = -77.47$, $\frac{V_2}{V_1} = 33.4$,

$R_{in} = 23.29K$ ohms, $R_{out} = 10K$ ohms)

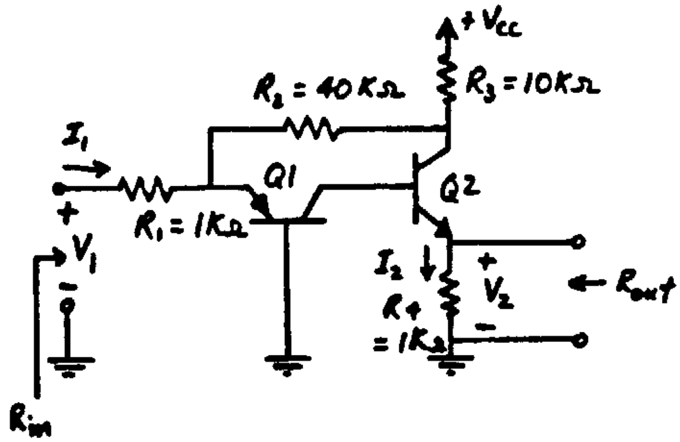


16.) In the feedback circuit shown, assume that all the transistors are equal with $\beta=100$, $r_\pi=1000$ ohms, and $r_u=r_o=\infty$. Do not assume that the loop gain is much greater than unity. Use the techniques of feedback analysis to find V_2/V_1, R_{in}, and R_{out}.

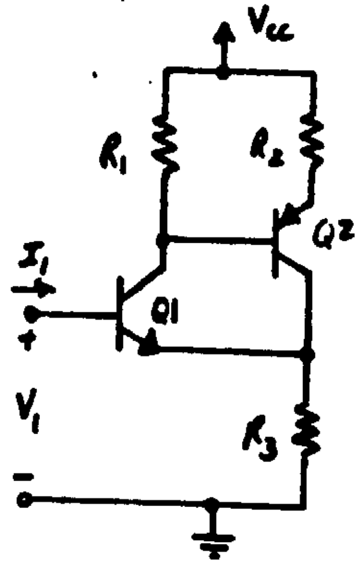
(Answer: $\frac{V_2}{V_1} = 9.899$, $R_{in} = 1010.1$ ohms, $R_{out} = 10K$ ohms)



17.) For the feedback amplifier shown, find V_2/V_1, I_2/I_1, R_{in}, and R_{out}. Assume that Q1 and Q2 are identical with small signal parameters of r_π=1000 ohms and β=100. Do not assume that $|A\beta|>>1$.
(Answer: $\frac{V_2}{V_1}$ = 4.805, R_{in} = 1000.476 ohms, R_{out} = 1K ohms)

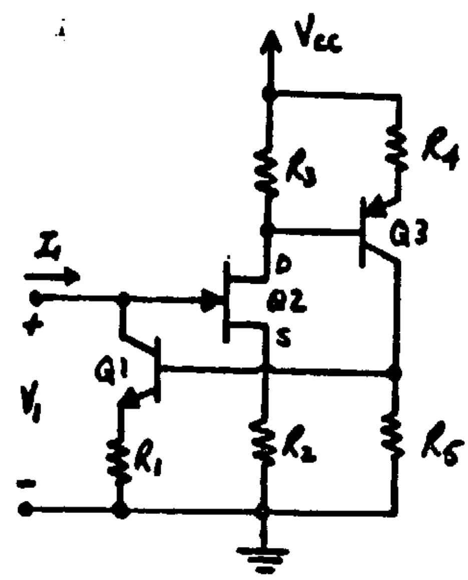


18.) For the circuit shown, assume that the β's of all BJT's and the g_m of all JFET's are very large, approaching infinity. Assume further that h_{ie}'s are zero and that r_d is infinite. Identify the topology, label the variables X_s, X_i, X_f, and X_o where X is a voltage or current, and find the approximate gain if a.) R_2 is the load resistor and b.) R_3 is the load resistor.
(Answer: a.) $\frac{I_o}{V_1} \simeq \frac{1}{R_3}$, b.) $\frac{V_o}{V_1} \simeq 1$)



19.) For the circuit shown, assume that the β of all BJT's and the g_m of all JFET's are very large, approaching infinity. Assume further that r_π's are zero and that r_d is infinite. Identify the topology, label the variables X_s, X_i, X_f, and X_o where X is a voltage or current, and find the approximate gain if a.) R_4 is the load resistor and b.) R_5 is the load resistor.

(Answer: a.) $\frac{I_o}{I_1} \approx \frac{R_1}{R_5}$, b.) $\frac{V_o}{I_1} \approx R_1$)



20.) A negative feedback circuit is shown. You are to use the assumption that $A\beta >> 1$.

1. Find the approximate value of the DC output voltage, $V_{out}(DC)$. (Answer: 11.3V)

2. Find the approxiate AC voltage gain, v_{out}/v_{in}. (Answer: 9)

3. Give an estimate of the open loop forward gain of this circuit if all the transistors have an β= 100. (Answer: A ≈ 6230)

4. If $1/(R_{.}C_1) << 1/(R_2C_2)$, find the lower -3dB frequency and the upper -3dB frequency. (Answer: f_{-3dB} (lower) = 15.9 Hz, f_{-3dB} (upper)=15.9KHz)