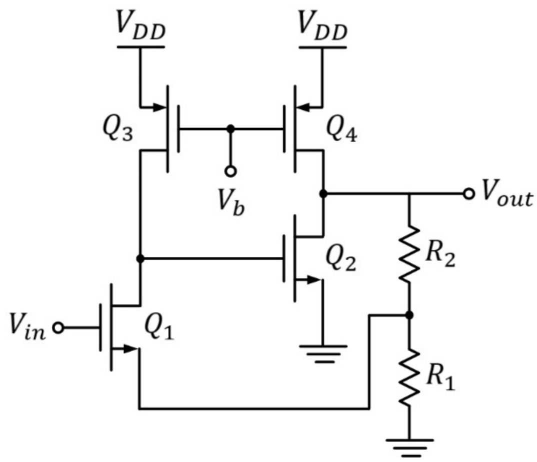
Sheet 6: Feedback Amplifiers

1) For a negative-feedback amplifier with closed-loop gain of $A_f = 100$ and an open-loop gain of $A = 10^4$
   i. Determine the feedback factor β
   ii. If a manufacturing error results in a reduction of A to 10^3, calculate the new closed-loop gain
   iii. What is the percentage change in A_f corresponding to the factor of 10 reduction in A?

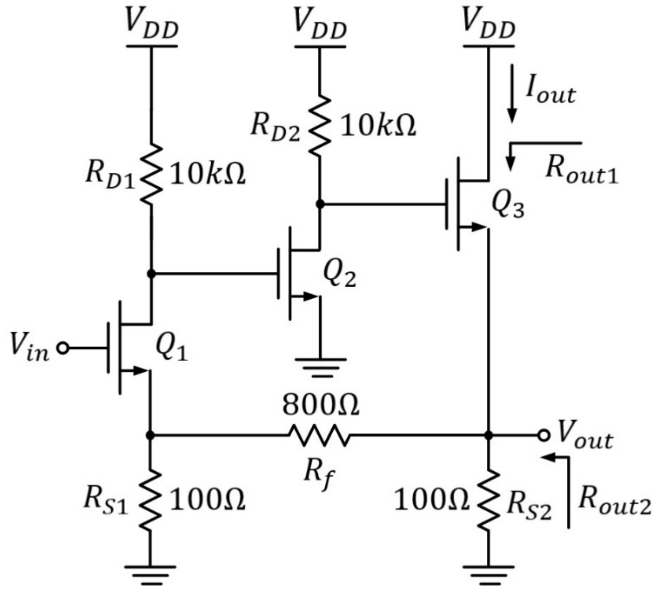
2) An amplifier has a midband gain of 1000, and a single high-frequency pole at $10KHz$. Negative feedback is employed so that the midband gain is reduced to 10. What are the upper $3dB$ frequencies of the closed-loop gain?

3) For the feedback amplifier shown, find an expression for the closed-loop gain and output impedance

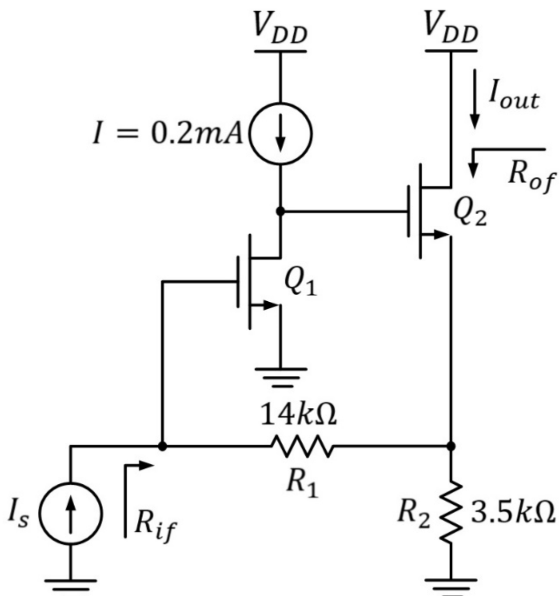


4) For the feedback amplifier shown below, all three MOSFETs are biased and sized to operate at $g_m = 4mA/V$. (Hint: You may neglect r_o except for the calculation of R_{out})
   i. Considering the feedback amplifier as a transconductance amplifier with output current I_{out}
      i. Sketch the A circuit and find the value of A
      ii. Calculate the closed-loop gain A_f
      iii. Assume that $r_{o3} = 20k\Omega$, find the output resistance R_{out1}

ii. If the voltage is taken as the output, in which case the amplifier becomes series–shunt feedback amplifier
    i. Sketch the A circuit and find the value of A
    ii. Calculate the closed-loop gain A_f
    iii. Assume that $r_{o3} = 20k\Omega$, find the output resistance R_{out2}



5) The feedback amplifier shown below utilizes two identical NMOS transistors sized so that at $I_D = 0.2mA$ they operate at $V_{ov} = 0.2V$. Both devices have $V_t = 0.5V$ and $V_A = 10V$
   i. If I_s has zero DC component, Find g_m and r_o for each transistor
   ii. Find the A circuit and calculate the value of A, R_i and R_o
   iii. Calculate the value of A_f, R_{if} and R_{of}



6) For the feedback amplifier shown below, find an expression for the closed-loop gain and output impedance