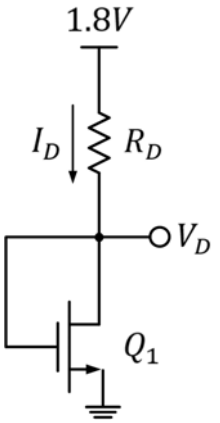
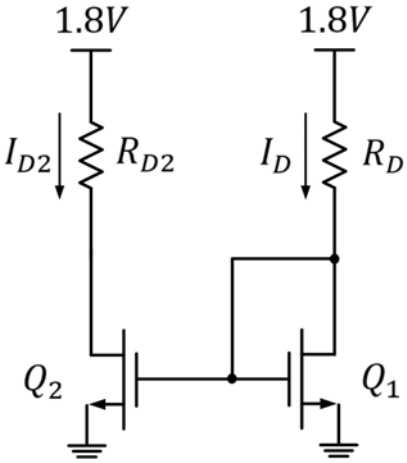
Sheet 1: DC Analysis of MOSFET

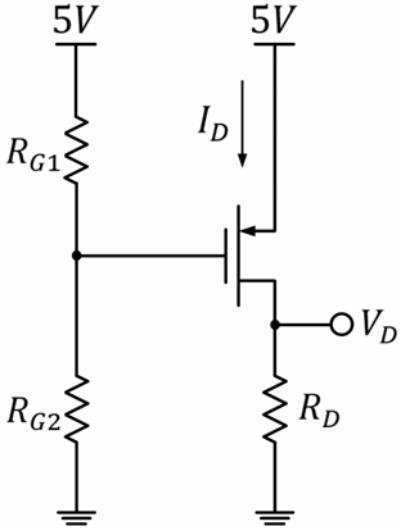
1) For the circuit, find the value of R that results in $V_D = 0.8V$. The NMOS transistor has $V_{Tn} = 0.5V$, $\mu_n C_{ox} = 0.4mA/V^2$, $L = 0.18\mu m$, and $W = 0.72\mu m$. Find the value of I_D.



2) The circuit shown is obtained by augmenting the circuit of Question (1) with a transistor Q_2 similar to Q_1 except for $W = 1.44\mu m$ and a resistance R_{D2}. Find the value of R_{D2} that results in operating Q_2 at the edge of the saturation region. Find the value of I_{D2}. Suggest an application for this circuit.



3) Design the circuit shown so that the transistor operates in saturation with $I_D = 0.5mA$ and $V_D = 3V$. The PMOS has $V_{Tp} = -1V$, and $k_p = 1mA/V^2$. What is the largest value that R_D can have while maintaining saturation-region operation?



4) The NMOS and PMOS transistors are matched, with $k_n = k_p = 1mA/V^2$ and $V_{Tn} = -V_{Tp} = 1V$. Find the drain currents I_{DN} and I_{DP}, as well as the voltage V_O, for $V_I = 0$, $-2.5V$, and $2.5V$.