1. (a) Calculate the drain current in an NMOS transistor if $K = 125 \, \mu A/V^2$, $V_{TO} = -2 \, V$, $\lambda = 0$, $V_{GS} = 0 \, V$, and $V_{DS} = 6 \, V$. [0.5 mA] (b) Repeat assuming $\lambda = 0.025 \, V^{-1}$. [0.575 mA] 

2. An n-channel MOSFET has $K = 125 \, \mu A/V^2$, $V_{TO} = 1 \, V$, and $\lambda = 0.02 \, V^{-1}$. At what drain current will the MOSFET no longer be able to provide any voltage gain when connected as a common-source amplifier? Note, the maximum gain is denoted by $\mu_F$ and it is given by $\mu_F = g_m r_0$. The object here is to determine the maximum $I_D$ such that $\mu_F \leq 1$. This will require you to select $V_{DS}$ that minimizes $\mu_F$ before solving for $I_D$. [1.25 A] 

3. A common-source amplifier has the drain load resistance $R_D = 60 \, k\Omega$ and a power supply voltage $V^+ = 18 \, V$. At what Q-point will $r_{out} = 50 \, k\Omega$ if the transistor has $\lambda = 0.02 \, V^{-1}$? Use the relations $r_0 = (\lambda^{-1} + V_{DS})/I_D$, $V_{DS} = 18 - I_D R_D$, and $r_{out} = r_0 || R_D$. [0.189 mA, 6.67 V] 

4. The drain current in an n-channel JFET is given by $i_D = I_{DSS} (1 - v_{GS}/V_P)^2$ for $v_{GS} > V_P$ and $i_D = 0$ for $v_{GS} \leq V_P$, where $I_{DSS} = I_{DSS0} (1 + \lambda v_{DS})$. For the n-channel JFET, $V_P < 0$. Show that the expression for the JFET current can be represented in exactly the same form as that of the MOSFET using the substitution $V_{TO} = V_P$ and $K = I_{DSS}/V_P^2$. 