1. Consider an enhancement NMOS transistor with $V_t = 2V$ which conducts a current $i_D = 1mA$ when $v_{GS} = v_{DS} = 3V$. What is the value of $i_D$ for $v_{DS} = 5V$? Calculate the value of the drain-to-source resistance for small $v_{DS}$ and $v_{GS} = 4V$.

2. For a 0.8-$\mu m$ process technology for which $t_{ox} = 20nm$ and $\mu_n = 650 \ cm^2/V \cdot s$, find $C_{ox}$, $k'_n$, and the overdrive voltage $V_{OV}$ required to operate a transistor having $\frac{W}{L} = 20$ in saturation with $I_D = 0.1mA$. What is the minimum value of $V_{DS}$ needed for the device to be in saturation?

3. An NMOS transistor having $V_t = 2V$, $k'_n = 100 \ \mu A/V^2$ and $\frac{W}{L}$ ratio of 20 is operated in the saturation region. Find the required $v_{GS}$ and the minimum required $v_{DS}$ for $i_D$ to be 0.4 mA.

4. An n-channel MOS device is fabricated in a 0.4-$\mu m$ process having $k'_n = 150\mu A/V^2$ and $V'_A = 40V/\mu m$ of channel length. If $L = 0.8\mu m$ and $W = 16\mu m$, find $V_A$ and $\lambda$. If the device is operated with an overdrive voltage of 1V and $V_{DS} = 2V$, what is the value of $I_D$? Find the value of $r_0$ at this operating point. If $V_{DS}$ is increased by 2V, what is the corresponding change in $I_D$?

5. A particular n-channel MOSFET is operated in the triode region with $v_{DS} = 50mV$. The drain current is found to be $45\mu A$ for $v_{GS} = 2V$ and $140\mu A$ for $v_{GS} = 4V$. Find the transistor threshold voltage $V_t$. If $k'_n = 100\mu A/V^2$, what is the device $\frac{W}{L}$ ratio? For $v_{GS} = 3V$ and $v_{DS} = 0.2mV$, what is the value of the drain current? If the transistor is operated at $v_{GS} = 4V$, at what value of $v_{DS}$ will the drain end of the MOSFET channel just reach the pinch off, and what is the corresponding drain current?