1. Given a NMOS transistor with $V_t = 2\text{V}$ which conducts a current $i_D = 1\text{mA}$ when $v_{GS} = 3\text{V}, v_{DS} = 2\text{V}$. What is the value of $i_D$ for $v_{DS} = 4\text{V}$ (ignore channel modulation effect)? Calculate the value of the drain-to-source resistance for small $v_{DS}$, e.g. $0.5\text{V}$, and $v_{GS} = 4\text{V}$.

2. Given an NMOS transistor with $L=0.2\mu\text{m}$, $W=2\mu\text{m}$, $t_{ox}=6\text{nm}$, $\mu_n = 400\text{cm}^2/\text{V.s}$, $V_t=0.5\text{V}$, and $\varepsilon_{ox}=34.5\text{ pF/m}$. Assume $\lambda=0$. (Include units in all your answers)
(a) Find $C_{ox}$ and $k_n'$.
(b) Given $i_D=0.8\text{mA}$, calculate the values of $v_{OV}$ and $v_{DS\text{min}}$ needed to operate the transistor in the saturation region
(c) Suppose the transistor is to be used as a $600\Omega$ resistor for very small $v_{DS}$. Find the required values of $v_{OV}$ and $v_{GS}$

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

4. A particular n-channel MOSFET is operated in the triode region with $v_{DS} = 50m\text{V}$. The drain current is found to be $45\mu\text{A}$ for $v_{GS} = 2\text{V}$ and $140\mu\text{A}$ for $v_{GS} = 4\text{V}$. Find the transistor threshold voltage $V_t$. If $k_n' = 100\mu\text{A/V}^2$, what is the device $\frac{W}{L}$ ratio? For $v_{GS} = 3\text{V}$ and $v_{DS} = 0.2m\text{V}$, what is the value of the drain current? If the transistor is operated at $v_{GS} = 4\text{V}$, 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?
5. Find the voltage $V_1$ given that $V_i = 1V$, $k_n = 2mA/V^2$ and $\lambda = 0$