

1. Given a NMOS transistor with $V_t = 2V$ which conducts a current $i_D = 1mA$ when $v_{GS} = 3V, v_{DS} = 2V$. What is the value of i_D for $v_{DS} = 4V$ (ignore channel modulation effect)? Calculate the value of the drain-to-source resistance for small v_{DS} , e.g. $0.5V$, and $v_{GS} = 4V$.
2. Given an NMOS transistor with $L=0.2\mu m, W=2\mu m, t_{ox}=6nm, \mu_n=400cm^2/V.s, V_t=0.5V$, and $\epsilon_{ox}=34.5 pF/m$. Assume $\lambda=0$. (Include units in all your answers)
 - (a) Find C_{ox} and k'_n .
 - (b) Given $i_D=0.8mA$, calculate the values of v_{OV} and v_{DSmin} needed to operate the transistor in the saturation region
 - (c) Suppose the transistor is to be used as a 600Ω 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 $0.4\text{-}\mu m$ 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 λ . 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 ?
4. 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?

5. Find the voltage V_1 given that $V_t=1V$, $k_n = 2mA/V^2$ and $\lambda=0$

