電子學(一) HW3

1. Consider a CMOS process for which L_{min}= 0.18 um, t_{ox} = 4 nm, μ_n = 450 $cm^2/V \cdot s$. and V_{tn} = 0.5 V.

(a) Find C_{ox} and k'_n.

(b) For an NMOS transistor with W/L = 2.4 μm/0.18 μm, calculate the values of V_{OV}, V_{GS} and V_{DSmin} needed to operate the transistor in the saturation region with a current I_D = 0.1 mA.

(c) For the device in (b), find the values of V_{OV} and V_{GS} required to cause the device to operate as a 500-Ω resistor for very small V_{DS}.

2. A particular MOSFET for which V_{tn}, = 0.4 V and $k'_n(W/L) = 2\text{mA}/V^2$ is to be operated in the saturation region. If I_D is to be 50 μA, find the required V_{GS} and the minimum required V_{DS}. Repeat for I_D,= 200 μA.

3. The table above lists the terminal voltages of a PMOS transistor in six cases, labeled a, b, c, d, e and f. The transistor has V_{tp} = -1 V. Complete the table entries.

	V_S	V_G	V_D	V_{SG}	$\lvert V_{OV}\rvert$	V_{SD}	Region of operation
a	+2	+2	0				
b	+2	+1	0				
c	+2	0	0				
d	+2	0	+1				
e	+2	0	+1.5				
f	+2	0	+2				

4. For the circuit in Fig.E5.10, assume that Q_1 and Q_2 are matched except for having different widths, W_1 and W_2. Let $V_t = 0.5V$, $k_n' = 0.4mA/V^2$, $L_1 = L_2 = 0.36\mu m$, $W_1 = 1.8\ \mu m$, and $\lambda = 0$.

(a) Find the value of R required to establish a current of 100μA in Q_1.

(b) Find W_2, and R_2, so that Q_2 operates at the edge of saturation with a current of 0.5 mA.

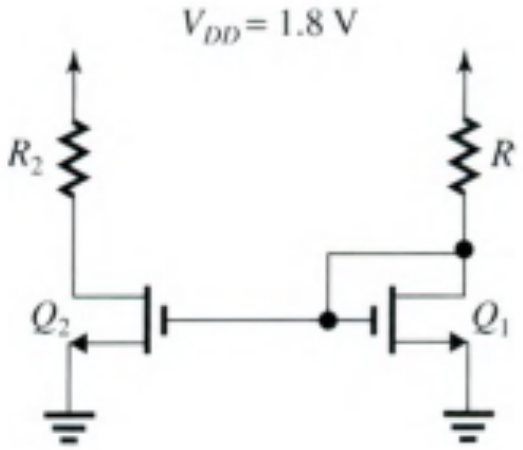

Figure E5.10