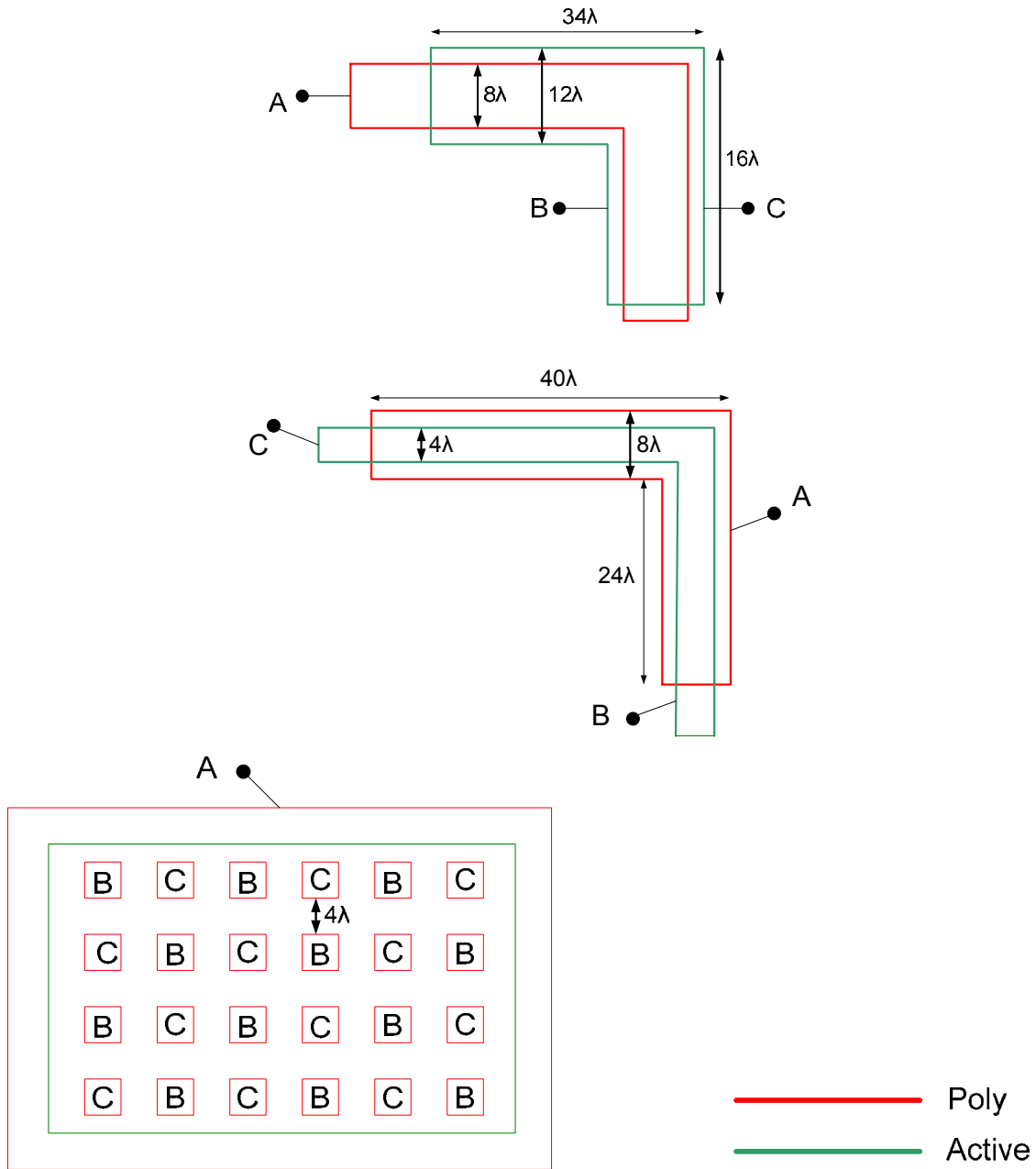
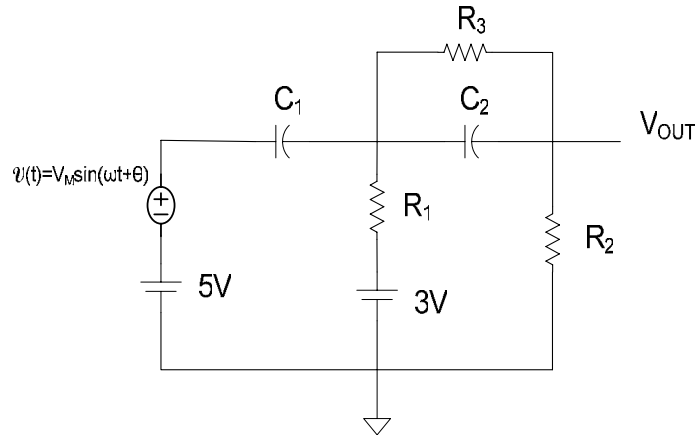


Problem 1

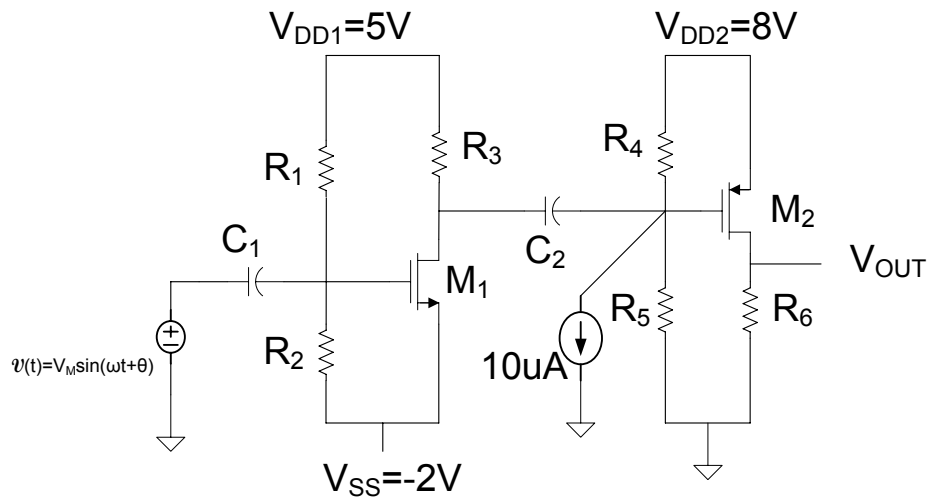


Three layouts of structures in a p-substrate are shown along with three connections to these structures, A, B, and C. In the third structures, the Poly squares are regions void of Poly. Describe what each of these devices are and give an approximate expression for the I-V characteristics for these devices. Have fun!

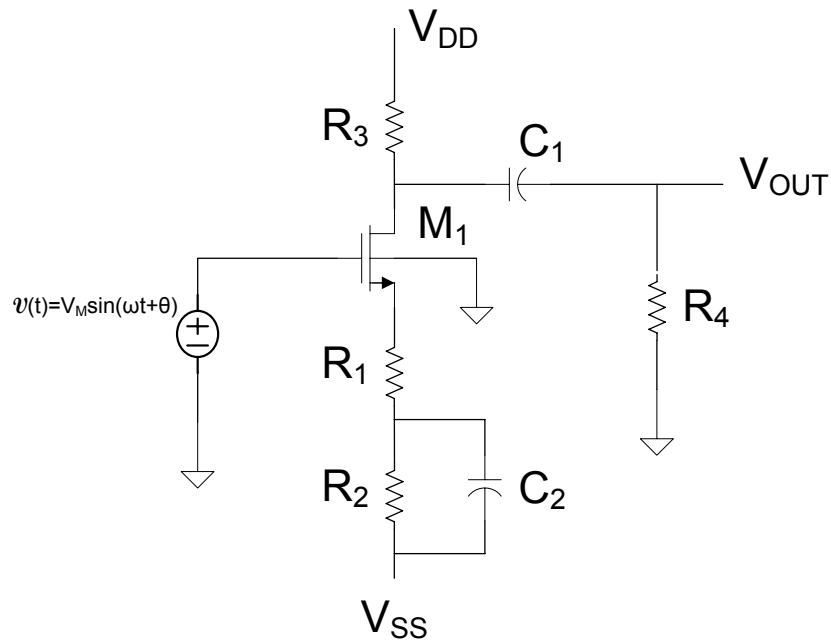
Problem 2 Obtain the AC equivalent and the DC equivalent circuit for the following network. You need not solve the circuit. Assume the capacitor C_1 is large and the capacitor C_2 is small.



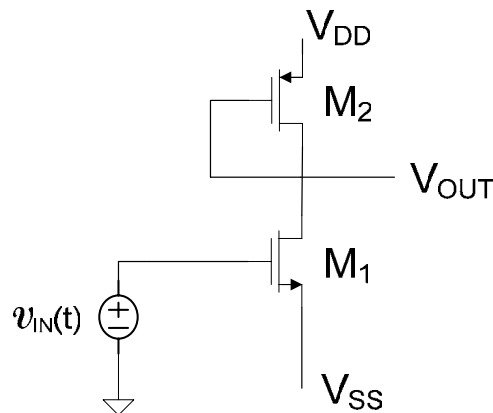
Problem 3 Obtain the AC equivalent and the DC equivalent circuit for the following network. Assume the transistors are operating in the saturation region and all capacitors are large. You need not solve the circuit.



Problem 4 Obtain the AC equivalent and the DC equivalent circuit for the following network. Assume the transistors are operating in the saturation region and all capacitors are large. You need not solve the circuit.



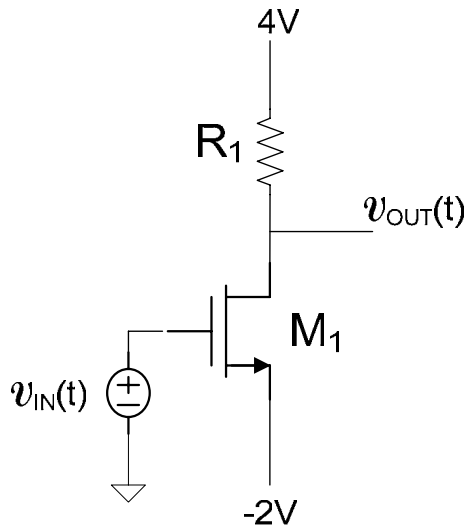
Problem 5 Obtain an expression for the small signal output voltage in terms of the small signal parameters if the input is given by the expression $v_{IN}(t) = V_M \sin(\omega t + \theta)$. Assume V_M is small and all capacitors are large.



Problem 6 Determine the total output voltage for the circuit in Problem 4 if $V_{DD}=5V$, $V_{SS}=-2V$, $W_1=10\mu$, $L_1=2\mu$, $W_2=4.5\mu$ and $L_2=1\mu$. Assume the devices are from a process with parameters $\mu_n C_{OX}=100\mu A/V^2$, $\mu_p C_{OX}=30\mu A/V^2$, $V_{TNO}=0.5V$, $V_{TPO}= - 0.5V$, $C_{OX}=2fF/\mu^2$, $\lambda = 0$, $\gamma = 0$.

Problem 7

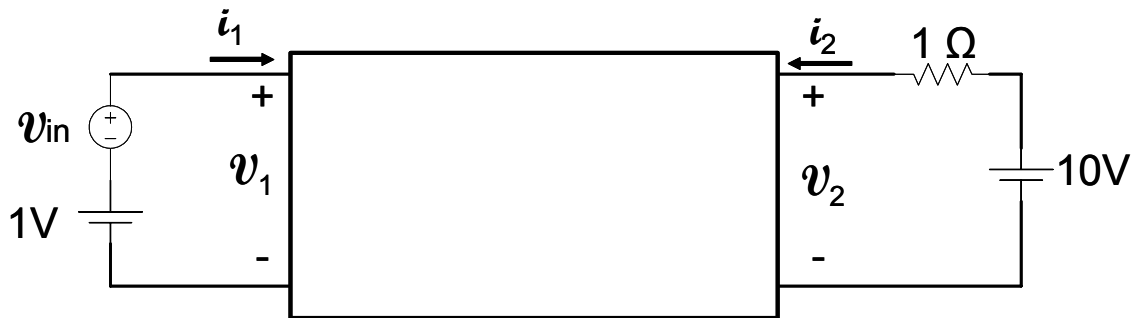
- Determine the maximum value of R_1 that will keep M_1 in saturation. M_1 has dimensions $W=10\mu$ and $L=1\mu$ and is in a process with $\mu_n C_{OX}=100\mu A/V^2$, $\mu_p C_{OX}=30\mu A/V^2$, $V_{TNO}=0.5V$, $V_{TPO}= - 0.5V$, $C_{OX}=2fF/\mu^2$, $\lambda = 0$, $\gamma = 0$.
- If R_1 is half of the value determined in Part a), determine the small signal voltage gain of this circuit
- With the value of R_1 used in part b), determine the total output voltage if $v_{IN}(t)=.001\sin(5000t+75^\circ)$.



Problem 8 A two-port nonlinear network is shown below. The nonlinear relationship between the port variables is given by the equations

$$I_1 = 0.2V_2 + V_1V_2^2$$

$$I_2 = 2V_1^3$$



- Determine the small signal model and a small-signal equivalent circuit in terms of V_{1Q} and V_{2Q}
- Determine the quiescent operating point for the circuit and numerical values for the parameters in the small signal model obtained in part a)
- Determine the small signal voltage gain from the v_{in} input to the v_2 output.