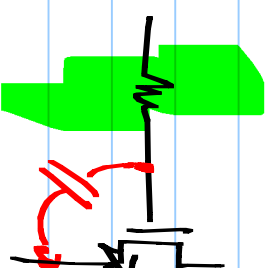
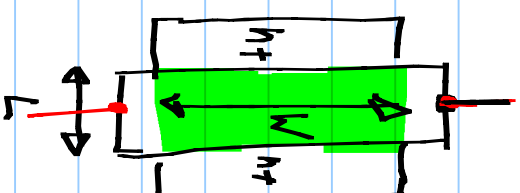
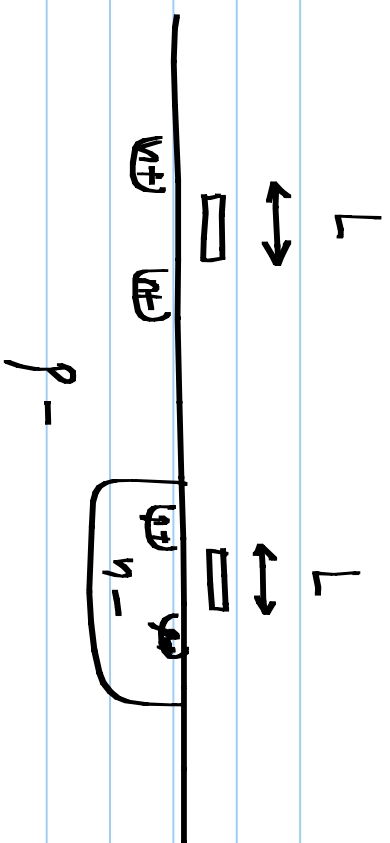
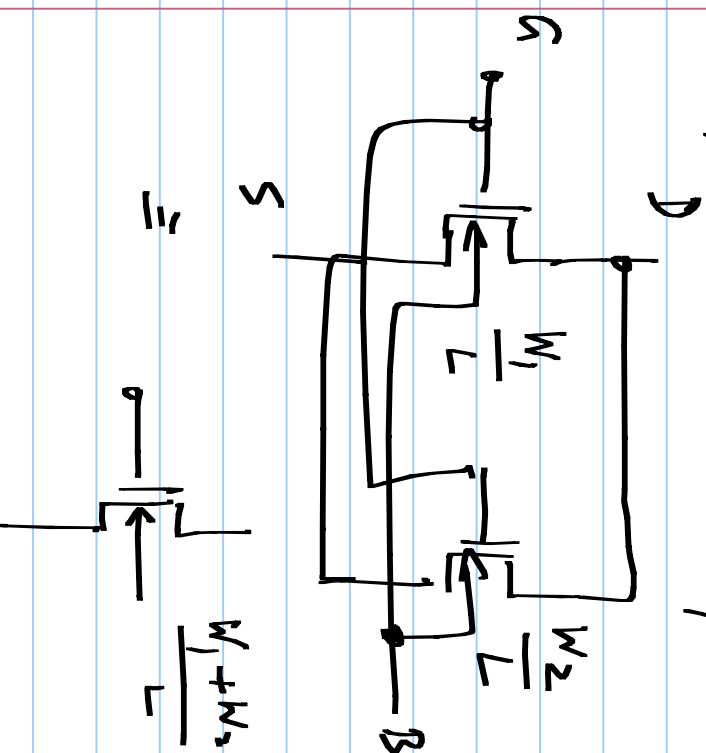
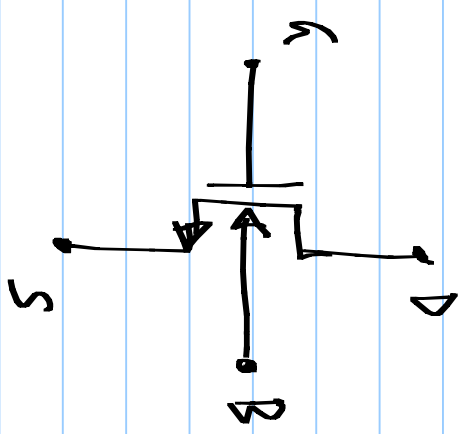
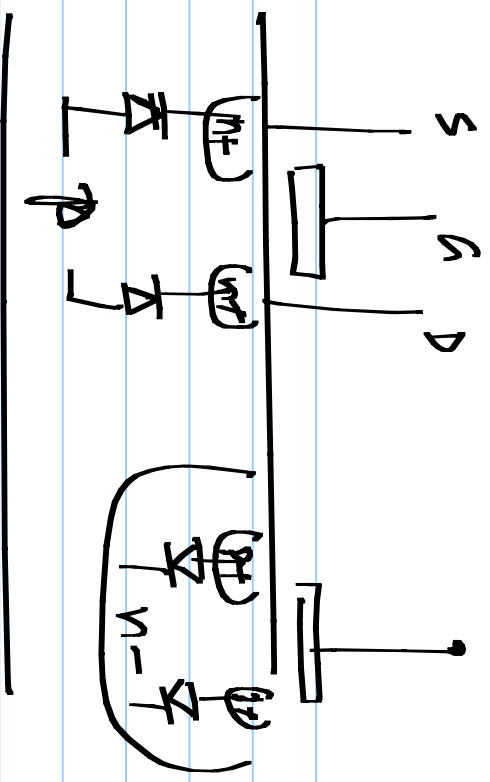


Lecture 5

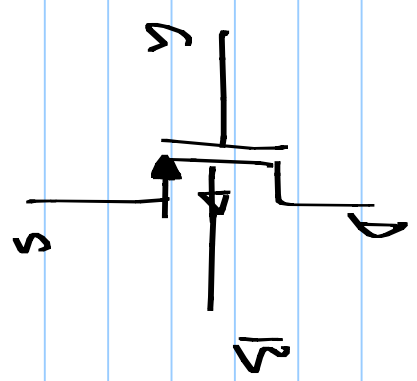
18/1/2016

$$\frac{105\mu\text{m}}{0.18\mu\text{m}} = 50 \times \frac{2\mu\text{m}}{0.18\mu\text{m}}$$

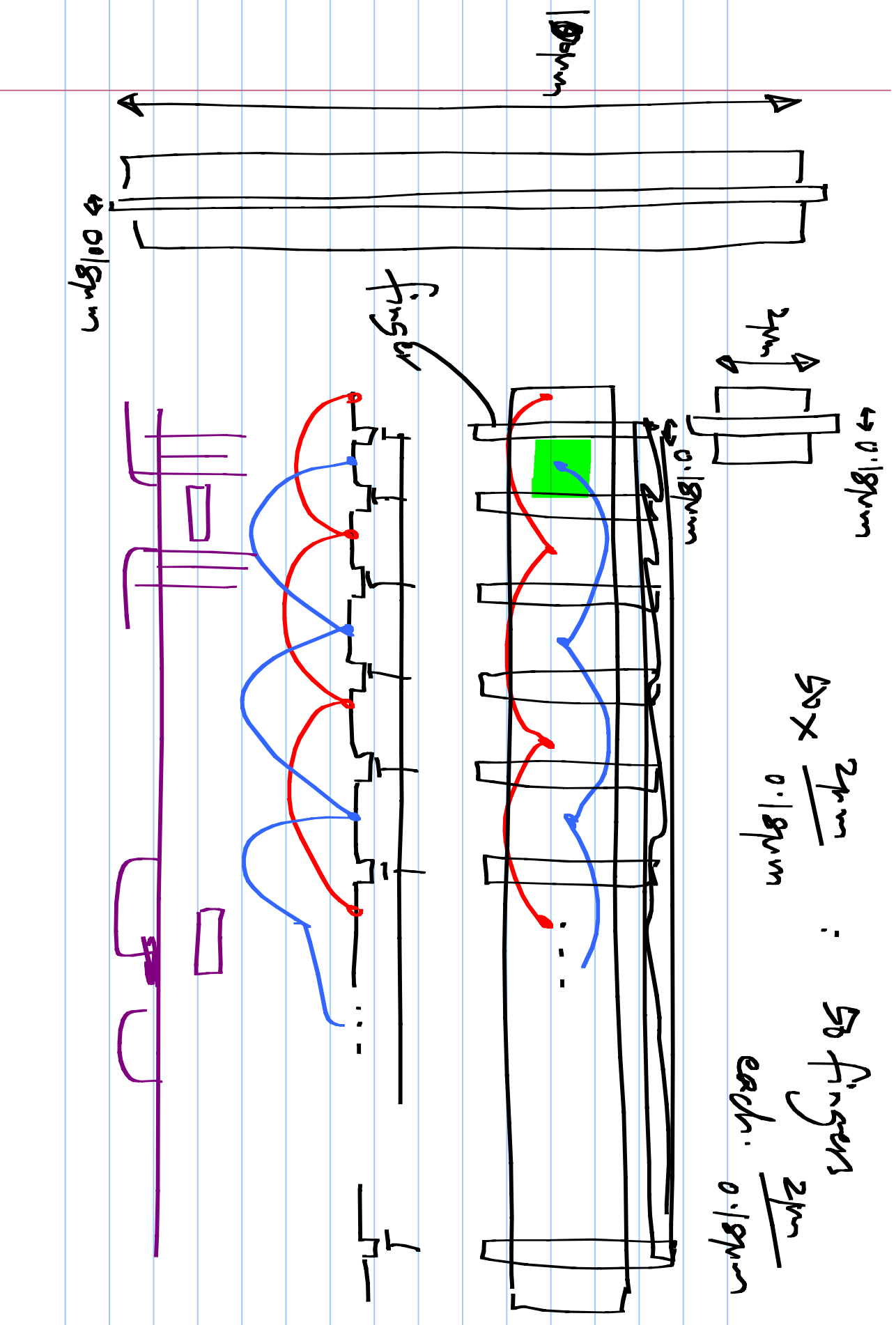


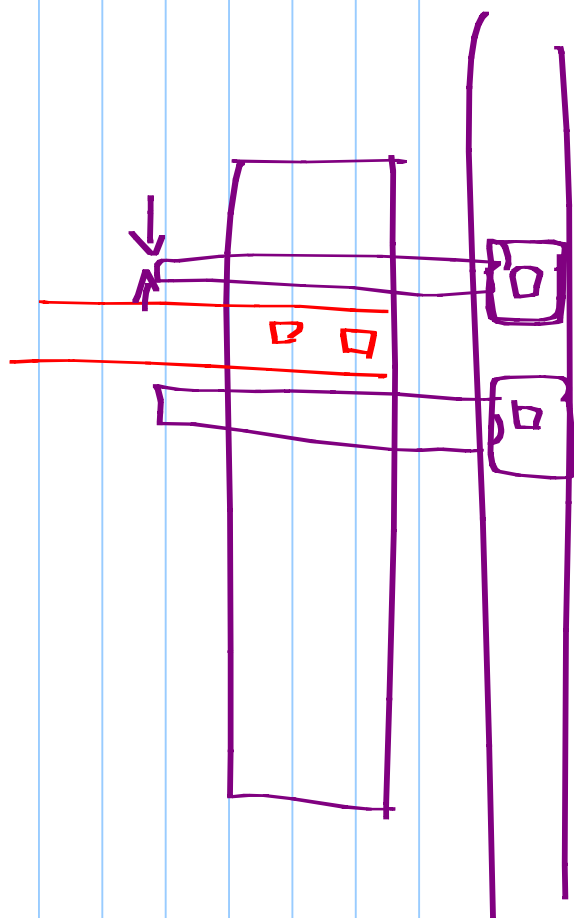


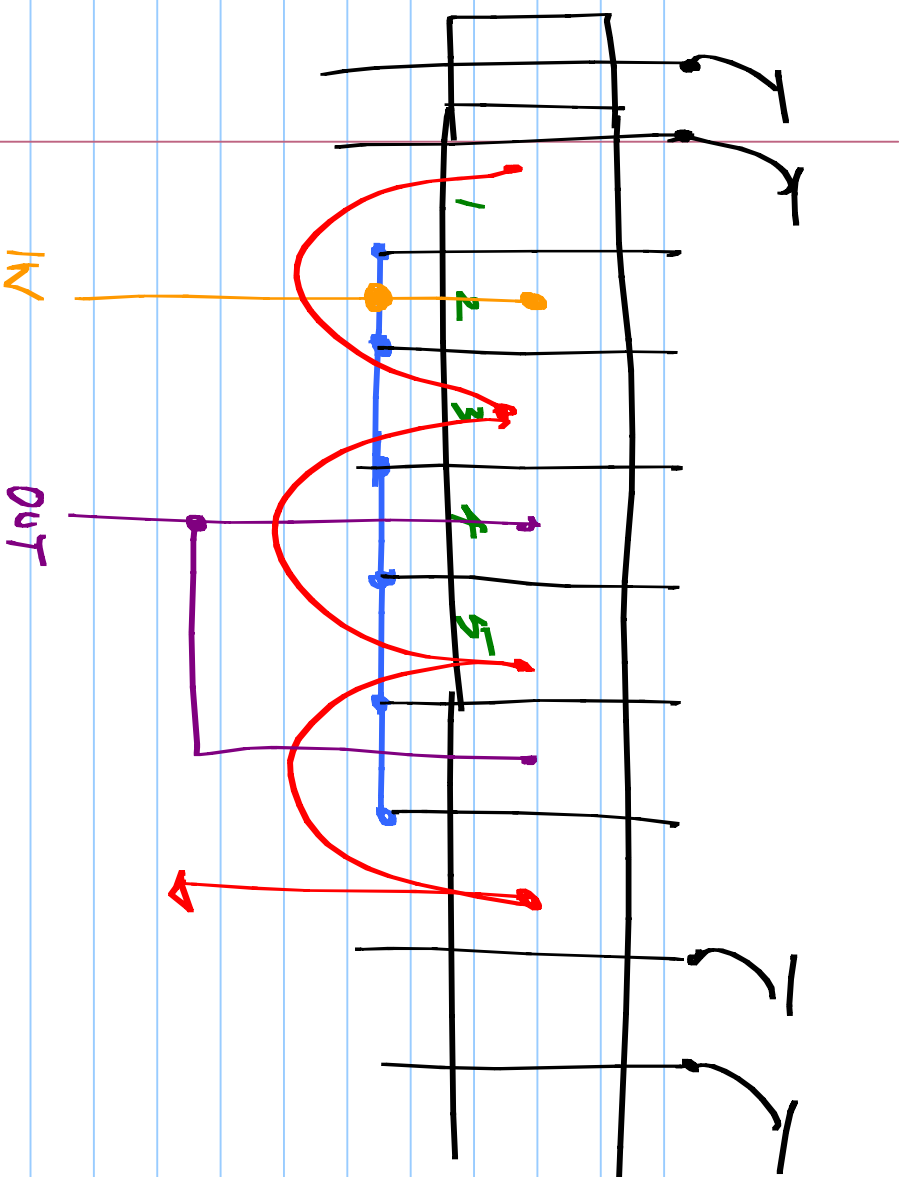
nMOS



pMOS

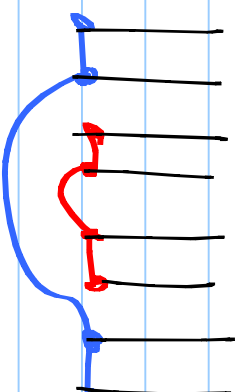
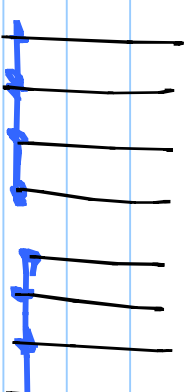




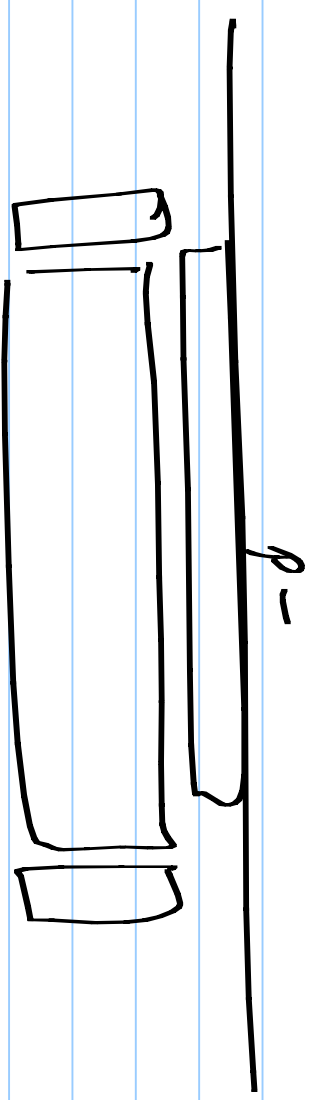
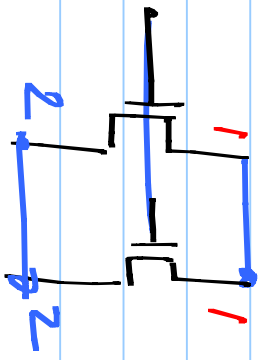
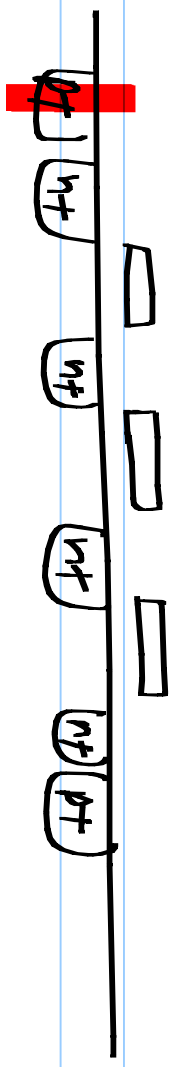
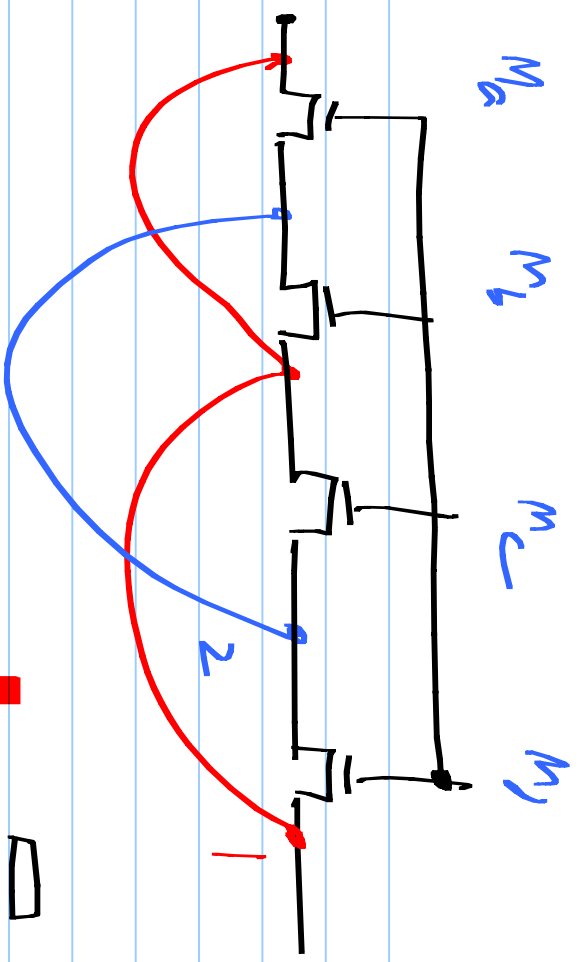


$4 : M_1$

$4 : M_2$



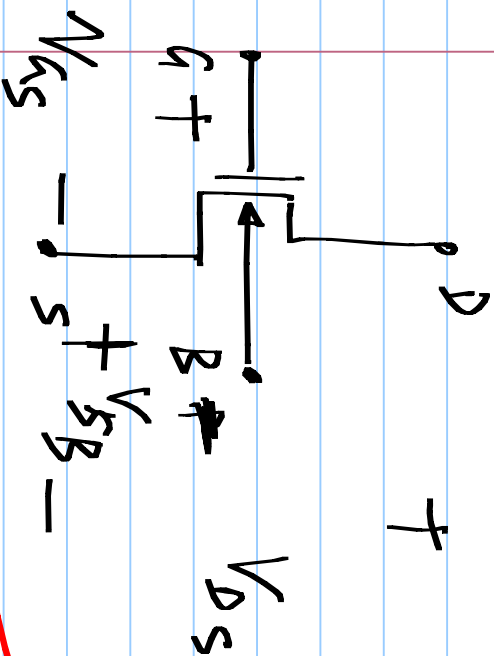
1:2 current mirror



$$\underline{V_{DS} > 0}$$

$$I_D = 0$$

$$V_{GS} < V_T$$



$$V_{SB} = 0$$

$$= \mu_n C_{ox} \frac{W}{L} \left((V_{GS} - V_T) V_{DS} - \frac{V_{DS}^2}{2} \right)$$

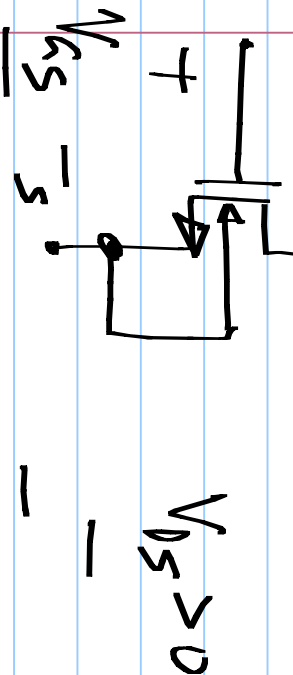
$$V_{GS} > V_T$$

$$V_{DS} < V_{GS} - V_T$$

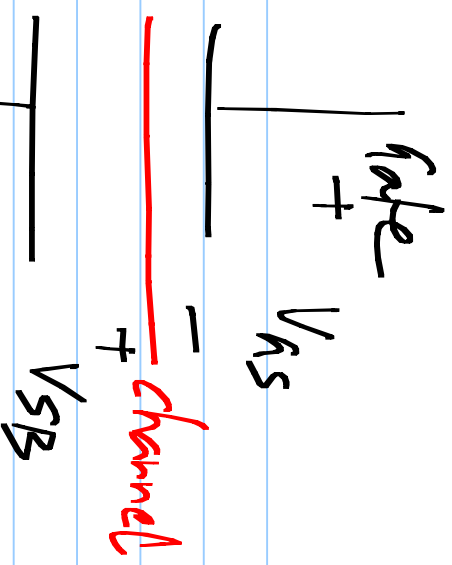
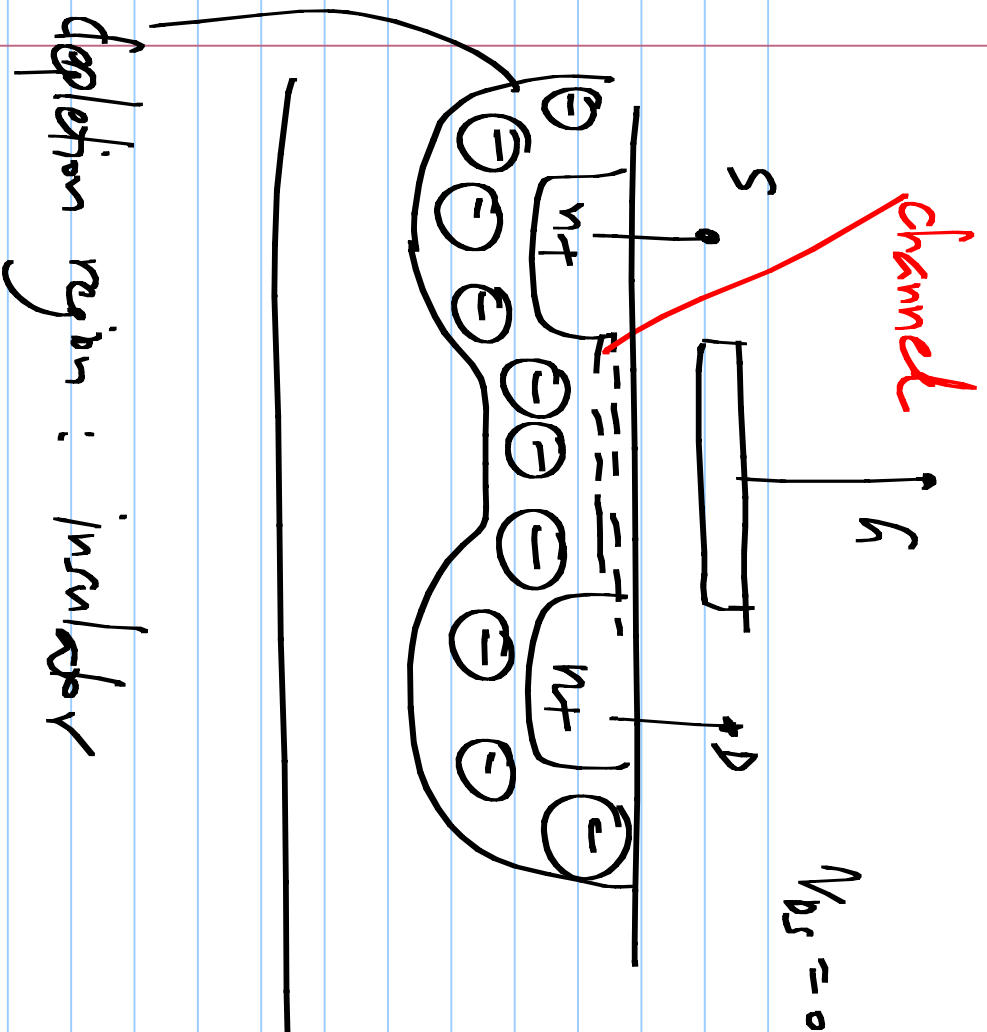
$$\frac{\mu_n C_{ox}}{2} \frac{W}{L} (V_{GS} - V_T)^2$$

$$V_{GS} > V_T$$

$$V_{DS} > V_{GS} - V_T$$



$$\underline{V_{GS} = 0}$$



$V_{SB} \uparrow$: $-ve$ charge

in the channel

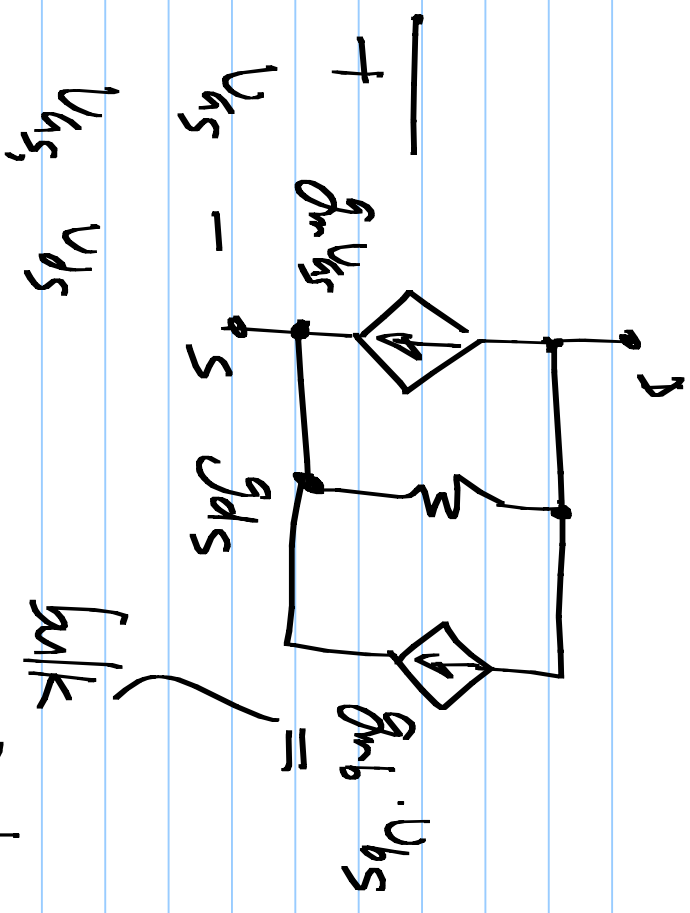
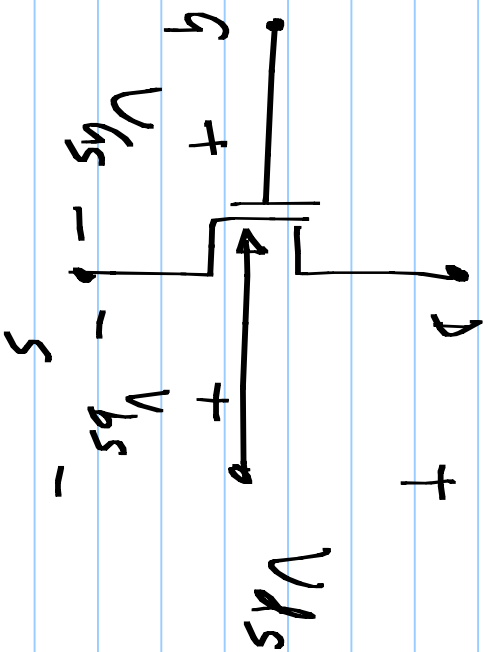
decreases

V_{SB} changes the threshold voltage V_T

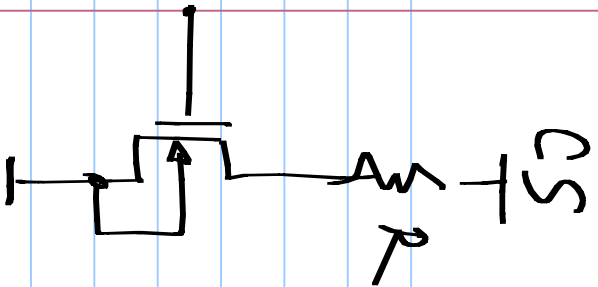
$$V_T = V_{T0} + \gamma \left(\sqrt{V_{SB} + 2\phi_f} - \sqrt{2\phi_f} \right)$$

$$V_T @ V_{SB} = 0$$

Body effect

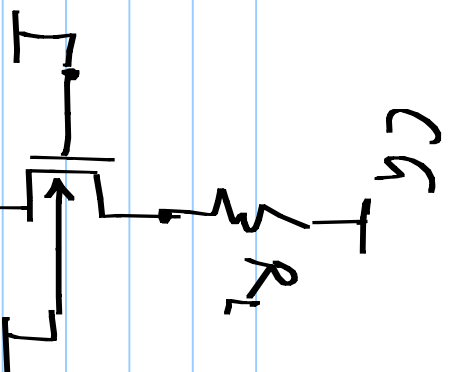


transconductance



$$g_m, g_{ds} = 0$$

$$g_{mb}$$



$$g_m, g_{ds} = 0$$

$$g_{mb}$$

