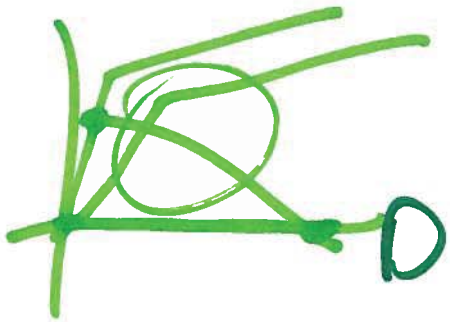
Lecture 16

EE 421/ECE 621

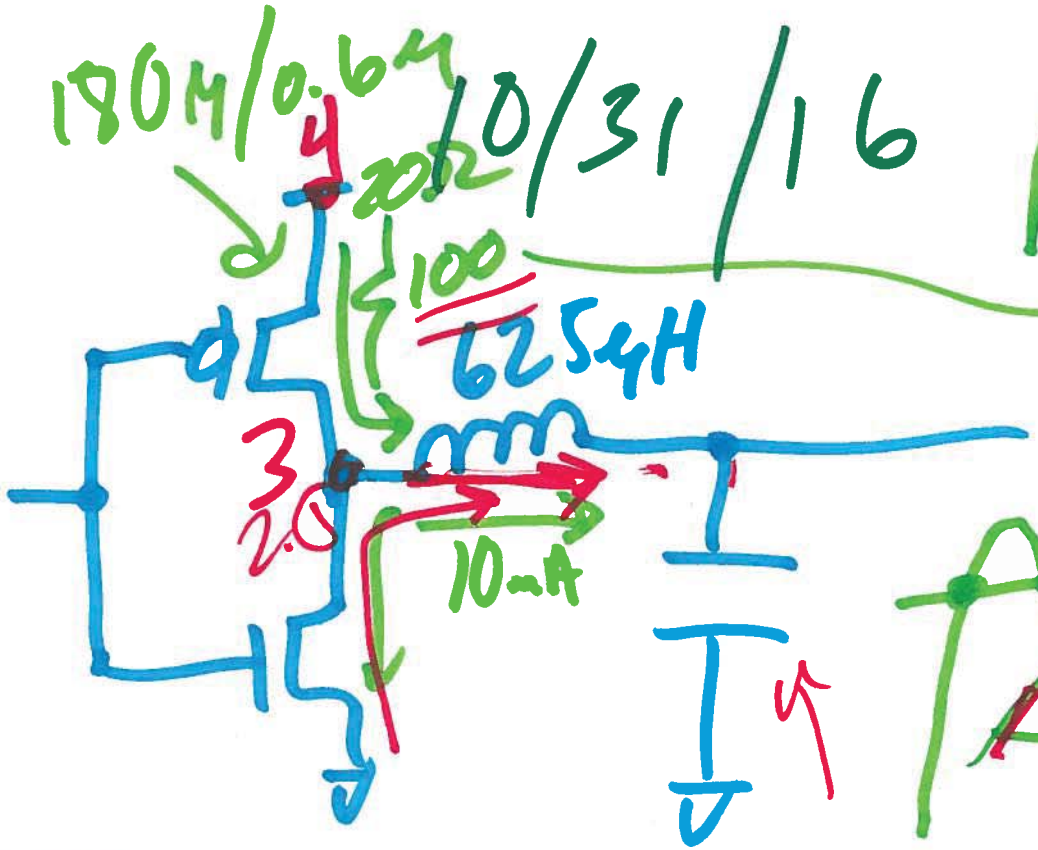
Digital IC Design

$R_p = R_p' \cdot \frac{L}{W}$



180M/0.6u

10/31/16



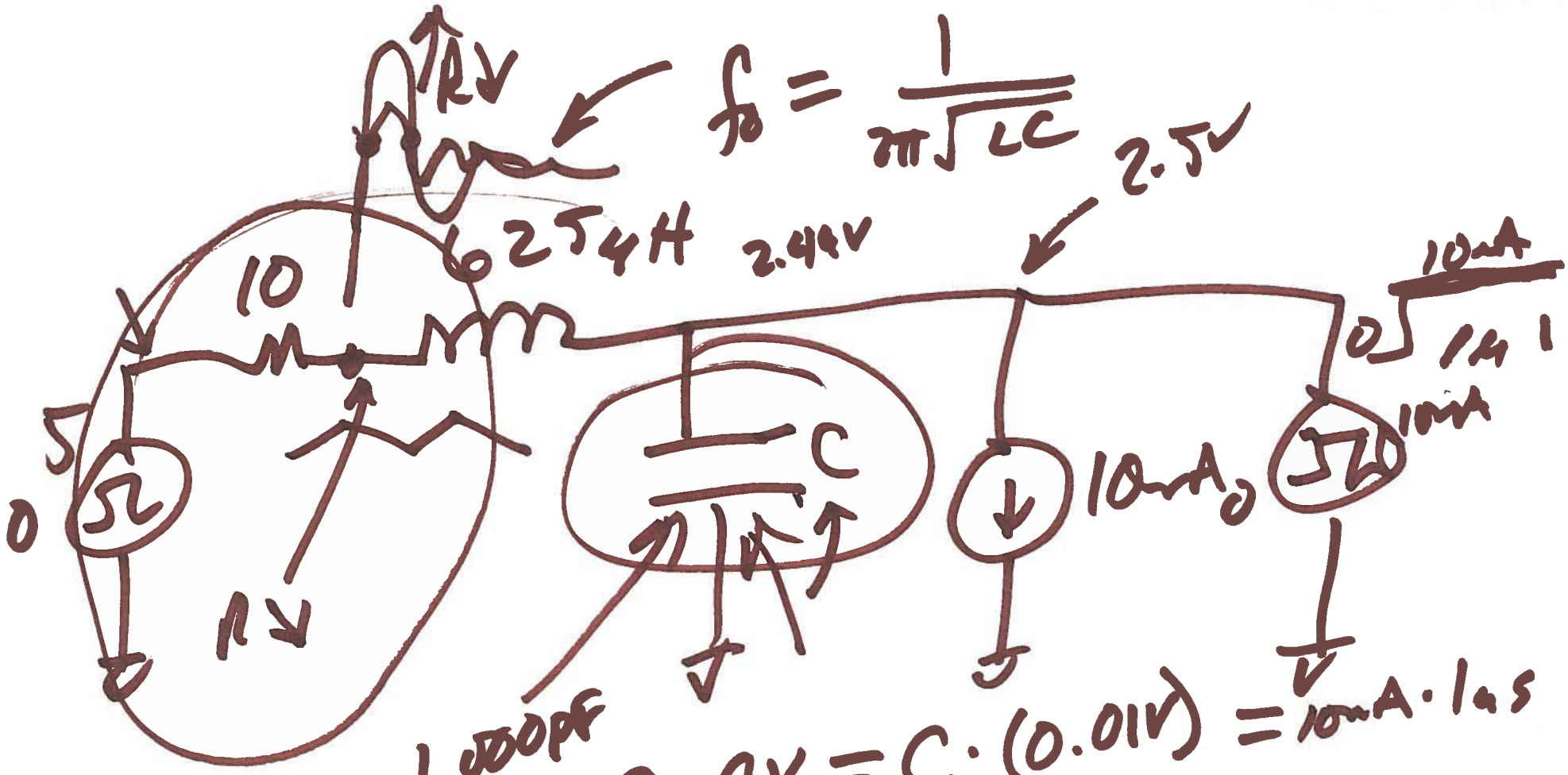
$R_p' = 30K$

$100 = 30K \cdot \frac{0.6u}{W}$

$W = \frac{30K \cdot 0.6u}{100}$

$= 300 \cdot .6$

$= 180$



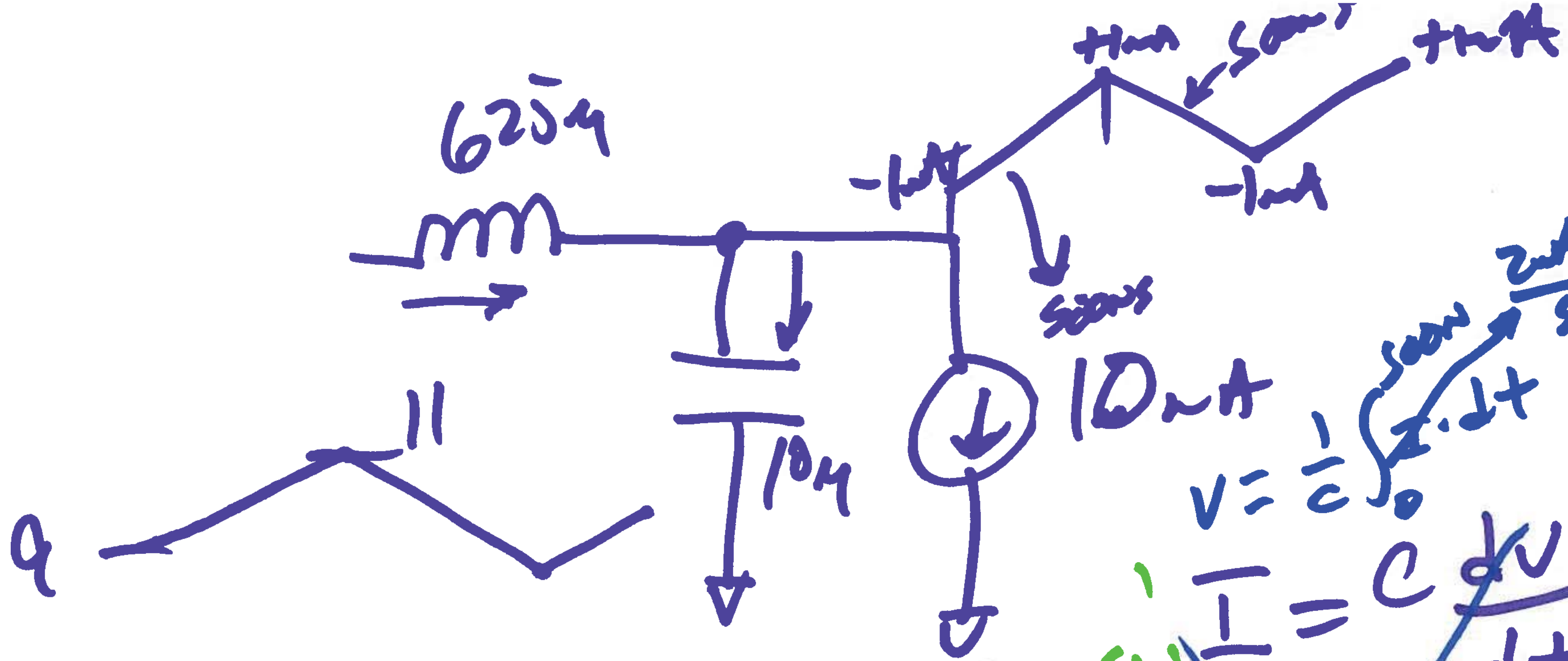
$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$Q = CV = C \cdot (0.01V) = 10mA \cdot 1\mu s$$

$$= 10pC$$

$$10mA \cdot t_r$$

$$C = \frac{10pC}{0.01} = 1000pF$$



$V = \frac{1}{C}\int_0^{500n} I \cdot dt$ $\qquad \frac{2mA}{500ns} \cdot t$

$I = C\frac{dV}{dt}$

$dV = \frac{2mA}{10\mu F} \cdot 500ns = 100\mu V$ (crossed out)

wrong! −10mA, .05, 10

$\frac{10^{-3} \cdot 10^{-9}}{10^{-6}}$

2.500.05

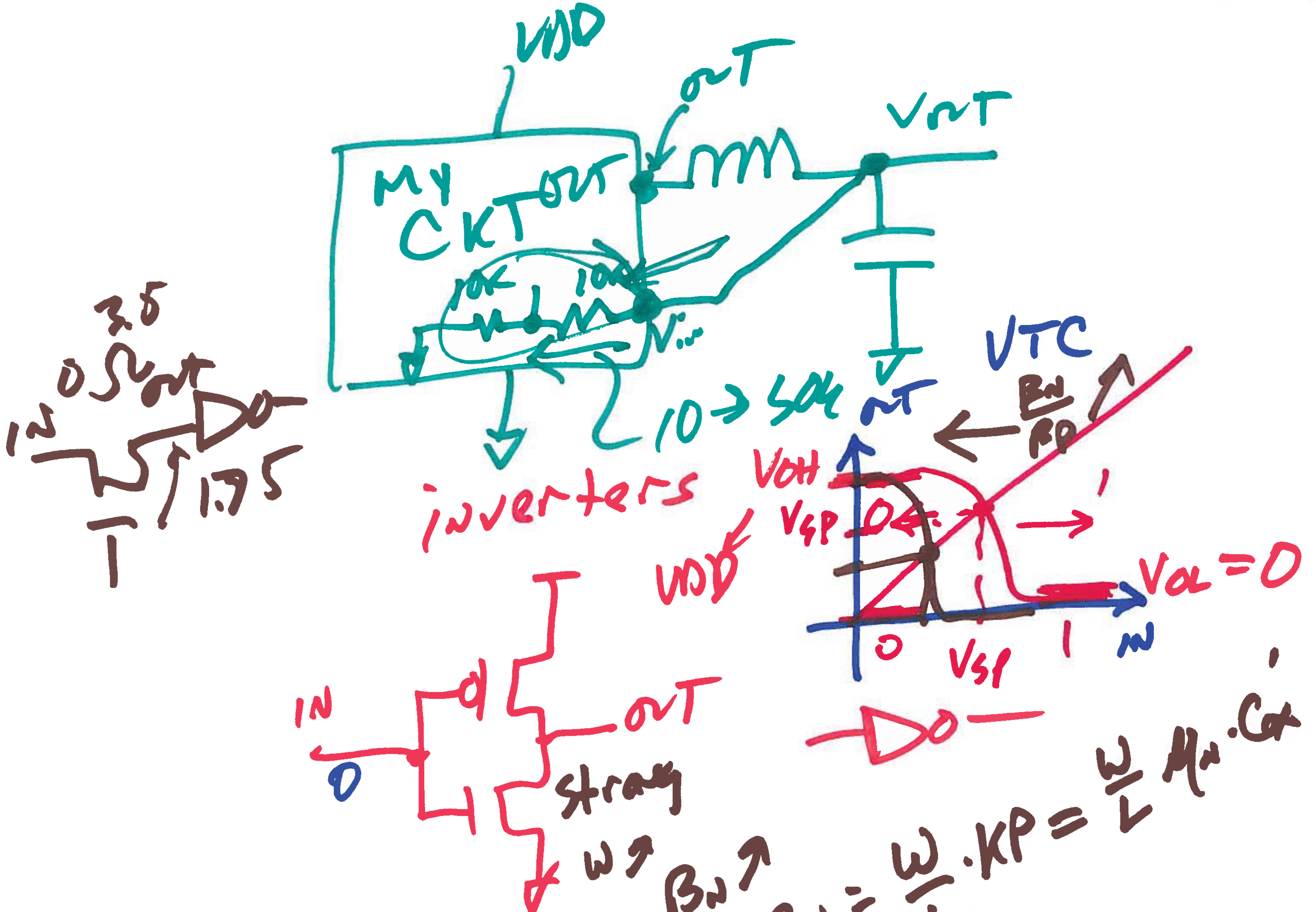
2.499.95

$$\Delta V = \frac{1}{10\mu} \int_0^{500ns} \frac{2mA}{500ns} \cdot t \cdot dt$$

$$\frac{1}{10\mu} \cdot \frac{2mA}{500ns} \left(\frac{t^2}{2} \Big|_0^{500ns} \right.$$

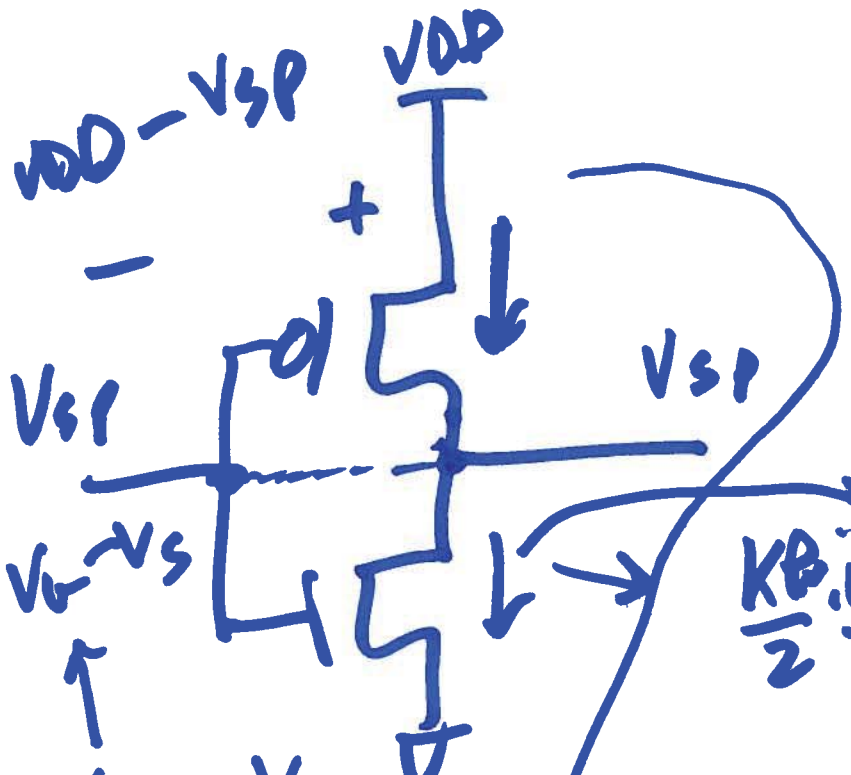
$$\Delta V = \frac{1}{10\mu} \cdot \frac{2mA}{2} \cdot 500ns$$

$$= \frac{500p}{10\mu} = \underline{\underline{50mV}}$$



$$\beta_N = \frac{W}{L} \cdot KP = \frac{W}{L} \mu_n \cdot C_{ox}'$$

Derive switching point



$$KP_N = \mu_N \cdot C'_{ox}$$

$$KP_P = \mu_P \cdot C'_{ox}$$

$$\frac{KP_N}{2} \cdot \frac{W_N}{L_N} \cdot (V_{SP} - V_{THN})^2 =$$

$$\frac{KP_P}{2} \cdot \frac{W_P}{L_P} (V_{DD} - V_{SP} - V_{THP})^2$$

$V_{DS} \geq V_{GS} - V_{THN}$

$V_D \geq V_G - V_{THN}$

yes

b)

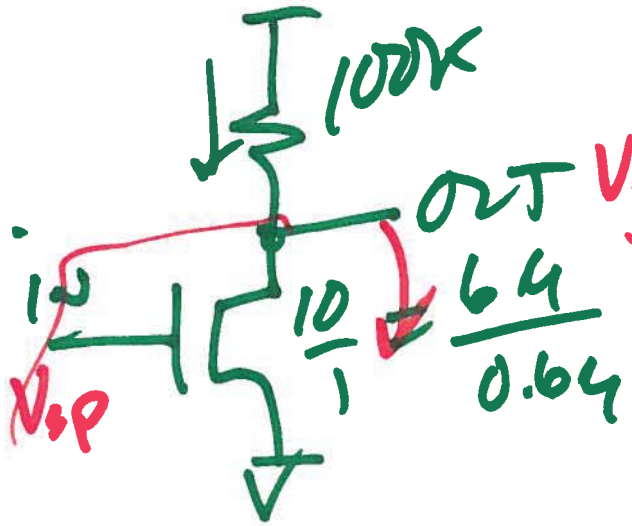
$$\frac{K_1}{\sqrt{\frac{K_N}{2}\frac{W_N}{L_N}}}\left(V_{SP}-V_{THN}\right)=\sqrt{\frac{K_P}{2}\cdot\frac{W_P}{L_P}}\left(VDD-V_{SP}-|V_{THP}|\right)$$

K_2

$$K_1\cdot V_{SP}-K_1\cdot V_{THN}=K_2\cdot VDD-K_2V_{SP}-K_2\cdot V_{THP}$$

$$V_{SP}(K_1+K_2)=K_2VDD-K_2V_{THP}+K_1V_{TH}$$

$$V_{SP}=\frac{\sqrt{\frac{K_P}{2}\cdot\frac{W_P}{L_P}}(VDD-V_{THP})+\sqrt{\frac{K_N}{2}\frac{W_N}{L_N}}\cdot V_{THN}}{\sqrt{K_P\frac{W_N}{2}\frac{W_N}{L_N}}+\sqrt{\frac{K_P}{2}\cdot\frac{W_P}{L_P}}}$$



$V_{OH} = VDD$

$I_D = K_P' C_{ox} (V_{GS} - V_{TH}) V_{SP}$

V_{DS}

$$\frac{VDD - V_{SP}}{100K} = \left(\frac{W_n}{L_n}\frac{K_P}{2}(V_{SP} - V_{TH})^2\right)$$

$$\frac{VDD - V_{OL}}{10K} = K_{P_n} \cdot C_{ox}' \cdot (V_{SP} - V_{TH}) V_{DL}$$