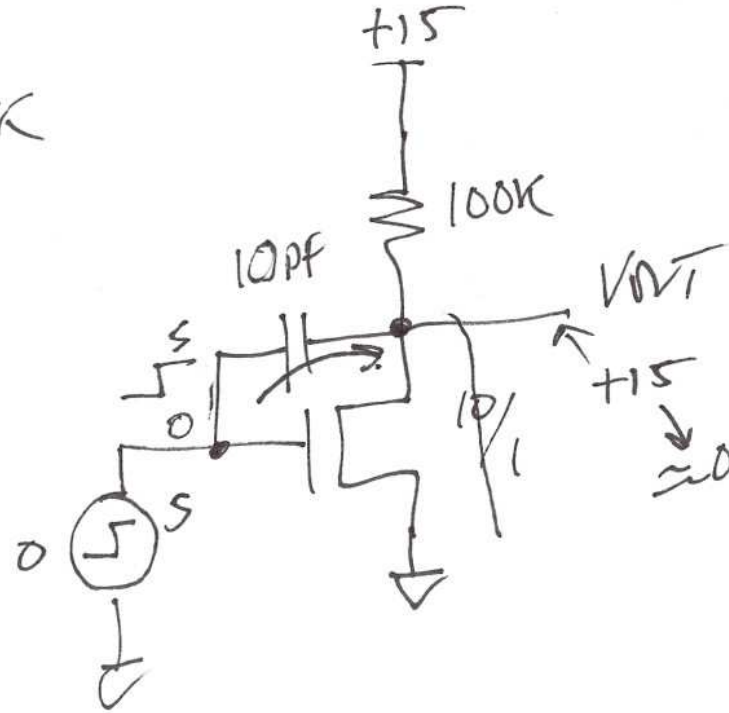


$R_{in}' = 25K$   
 $R_{in} = 25K$



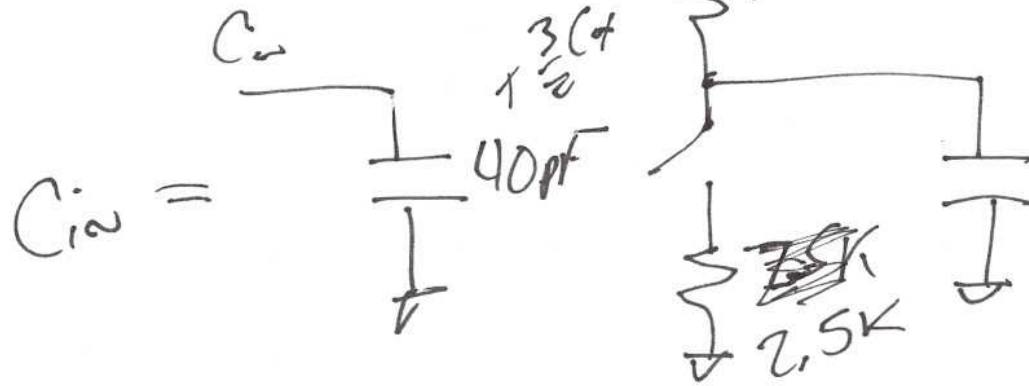
$C_{in} = ? = 40pF$

$t_{PHL} = ?$

$t_{PLH} = ?$

$t_{PHL} = 0.7 \cdot 2.5K \cdot (13.3pF + C_{in}' \cdot W \cdot L \cdot S^2)$

$t_{PLH} = 0.7 \cdot 100K \cdot (13.3pF + C_{in})$

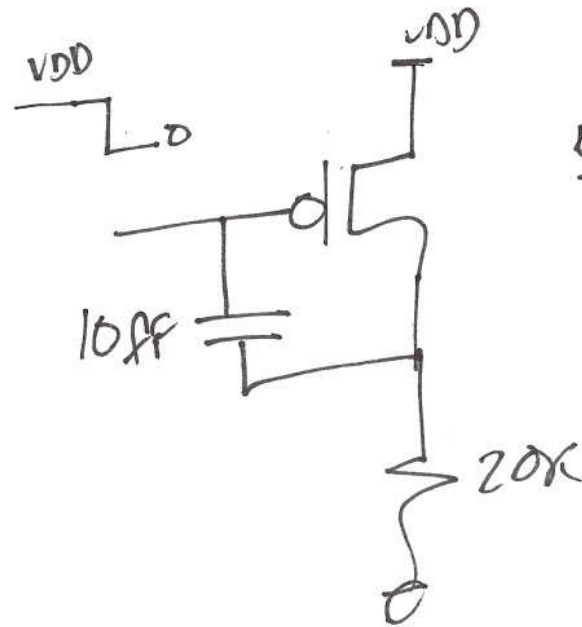


$10pF \left( 1 + \left| \frac{1}{31} \right| \right) = 13.3pF$

1)

$$C_x' = 2.5 \text{ fF}/\mu\text{m}^2$$

$$R_p' = 50 \text{ k}\Omega$$



$$C_{out} = \left( \frac{C_{ox}}{2} + 10 \text{ fF} \right) \cdot 2$$

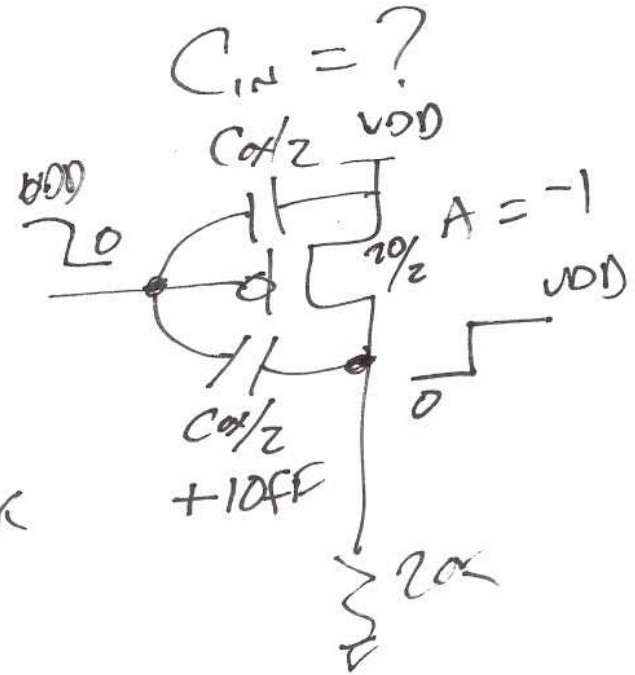
$$C_{out} = C_x + 20 \text{ fF}$$

$\nearrow R_p' \cdot \frac{2}{20}$

$$t_{PLH} = 0.7 \cdot R_p \cdot C_{out}$$

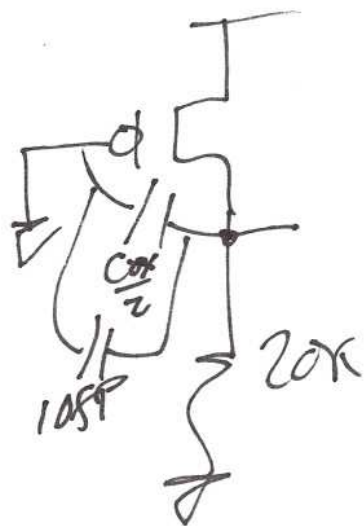
$$t_{PHL} = 0.7 \cdot 20 \text{ k}\Omega \cdot C_{out}$$

2)



$$C_{in} = \frac{C_{ox}}{2} + \left( \frac{C_{ox}}{2} + 10 \text{ fF} \right) (1 + A)^2$$

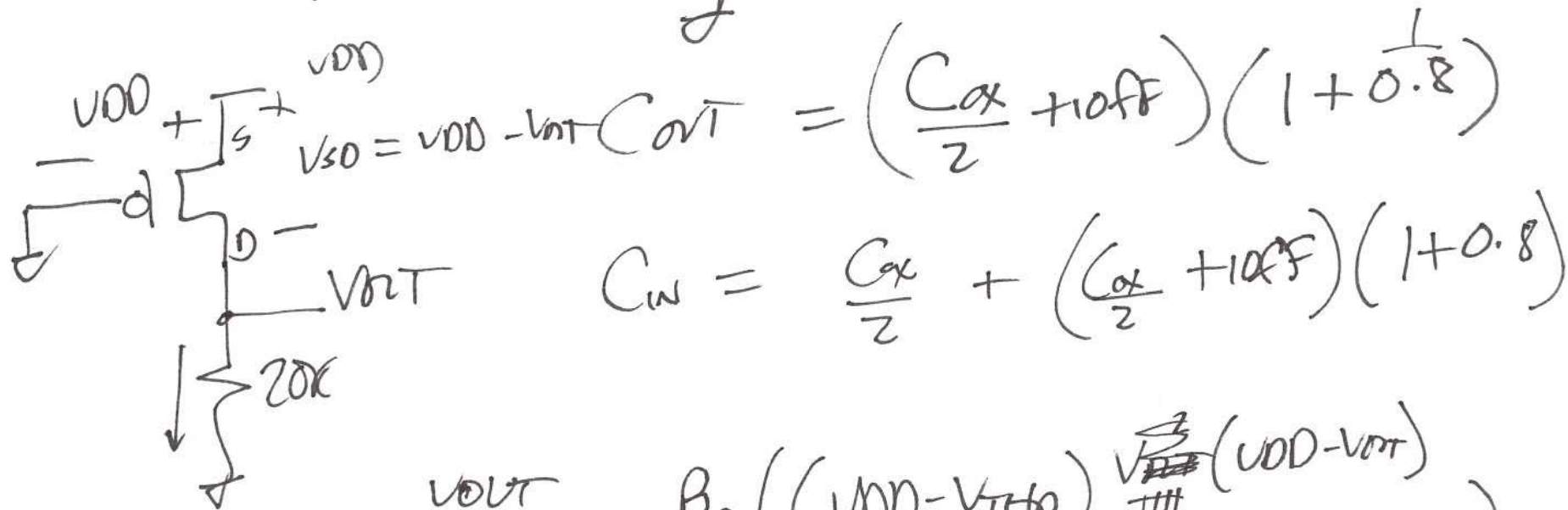
$$= \frac{3}{2} C_x + 20 \text{ fF}$$



$$50k \cdot \frac{2}{20} = 5k$$

$$V_{DT} = \frac{V_{DD} \cdot 20k}{20k + 5k}$$

$$= \underline{\underline{4V}}$$



$$V_{SD} = V_{DD} - I_{DT} C_{DT} = \left( \frac{C_{ox}}{2} + 100f \right) (1 + 0.8)$$

$$C_w = \frac{C_{ox}}{2} + \left( \frac{C_{ox}}{2} + 100f \right) (1 + 0.8)$$

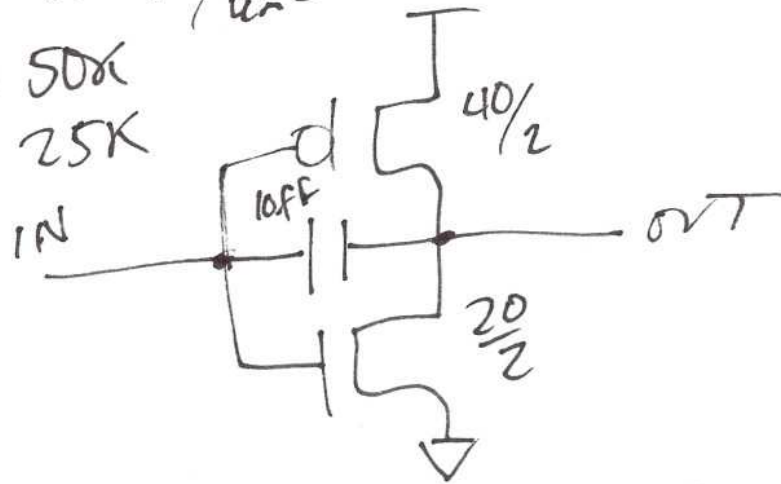
$$\frac{V_{DT}}{20k} = \beta_p \left( (V_{DD} - V_{THp}) \frac{V_{DD} - V_{DT}}{(V_{DD} - V_{DT})^2} \right)$$

3)

$$C_{ox}' = 7.5 \text{ fF}/\mu\text{m}^2$$

$$R_p = 50 \text{ k}\Omega$$

$$R_N = 25 \text{ k}\Omega$$



$$C_{in} = ?$$

$$C_{out} = ?$$

$$t_{PHL} = ? \quad t_{PLH} = ?$$

$$C_{in} = \frac{3}{2} C_{ox}' \cdot 40 \cdot 2 + \frac{3}{2} C_{ox}' \cdot 20 \cdot 2 + 10 \text{ fF} \cdot 2$$

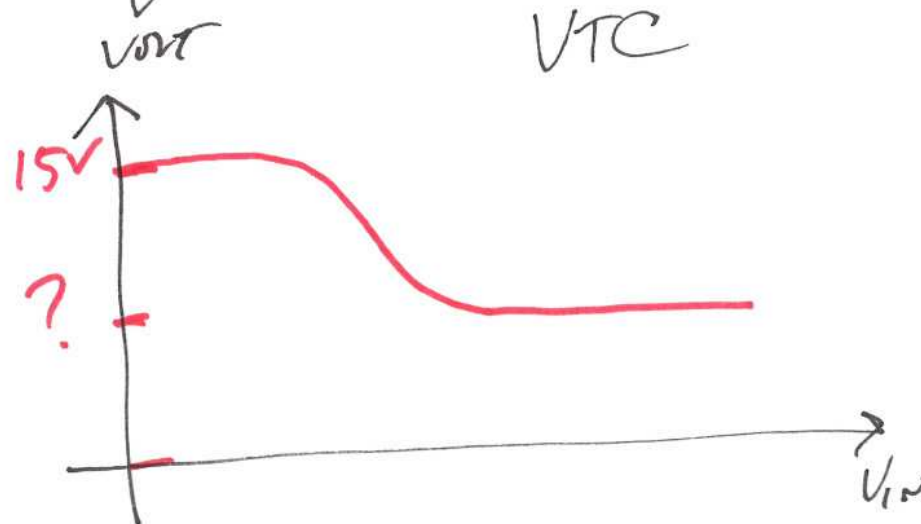
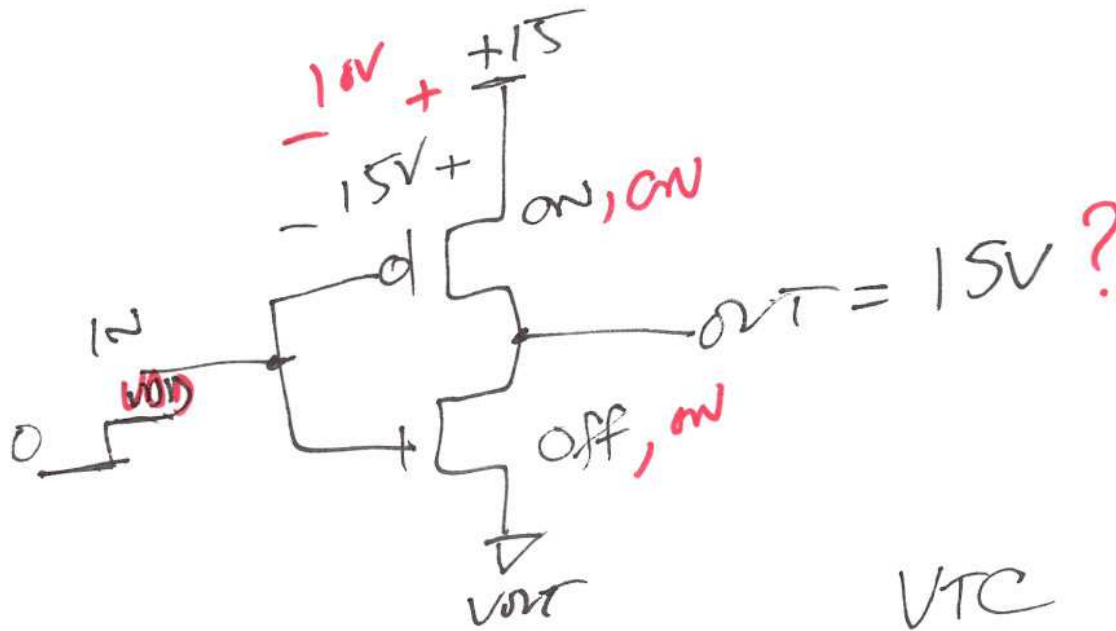
$$C_{out} = C_{ox}' \cdot 40 \cdot 2 + C_{ox}' \cdot 20 \cdot 2 + 10 \text{ fF} \left(1 + \frac{1}{A}\right)$$

$$t_{PHL} = 0.7 R_N \cdot C_{out}$$

$$t_{PLH} = 0.7 R_p \cdot C_{out}$$

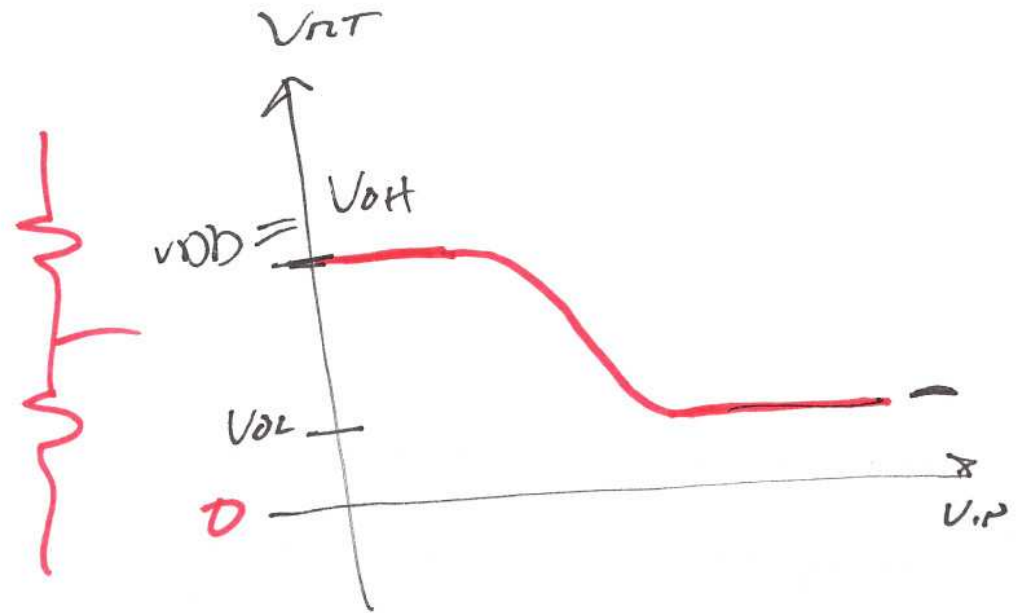
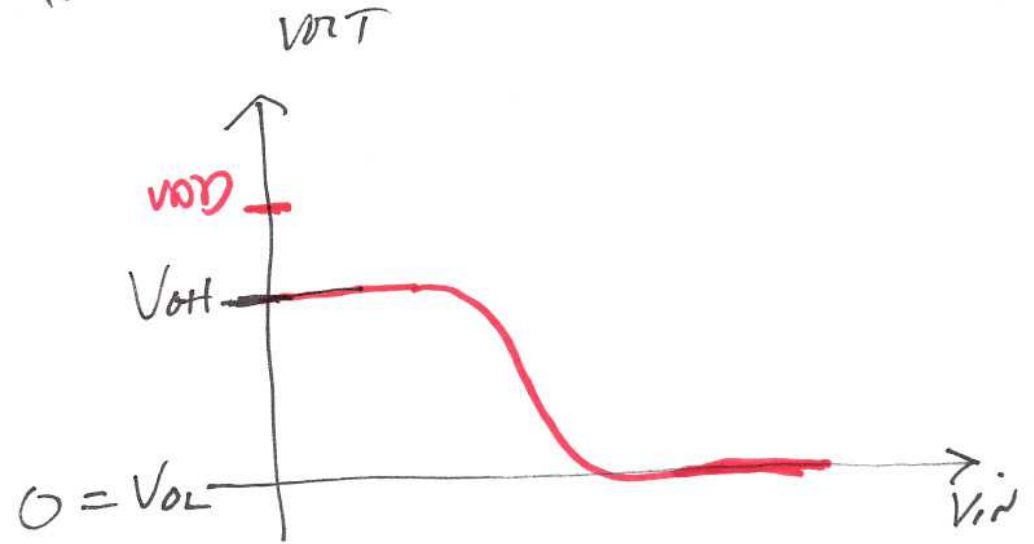
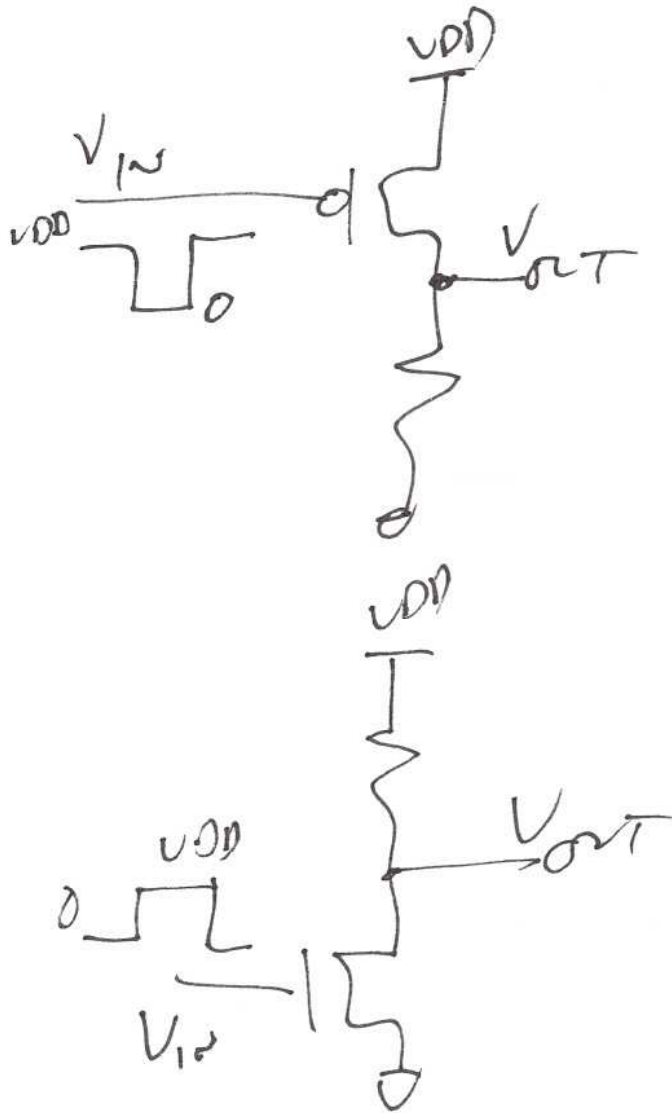
4)

What's wrong with this?

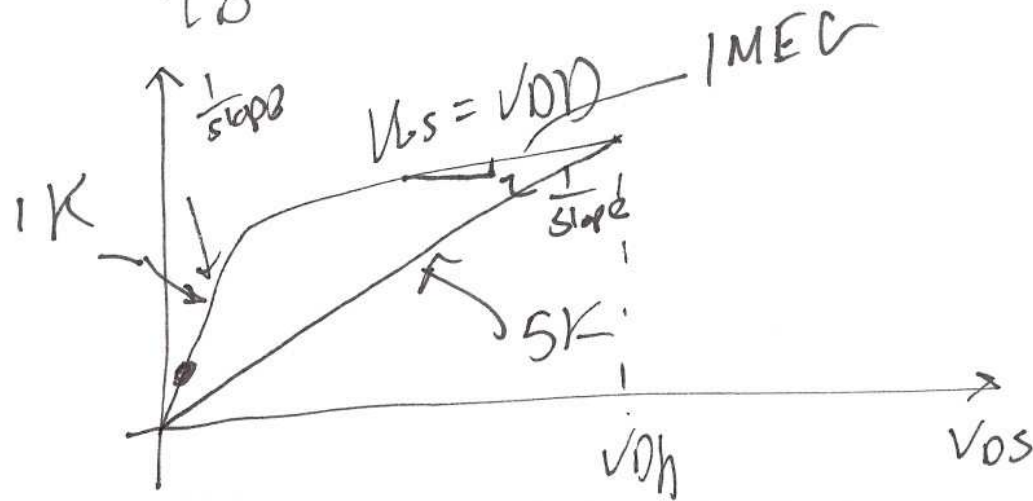
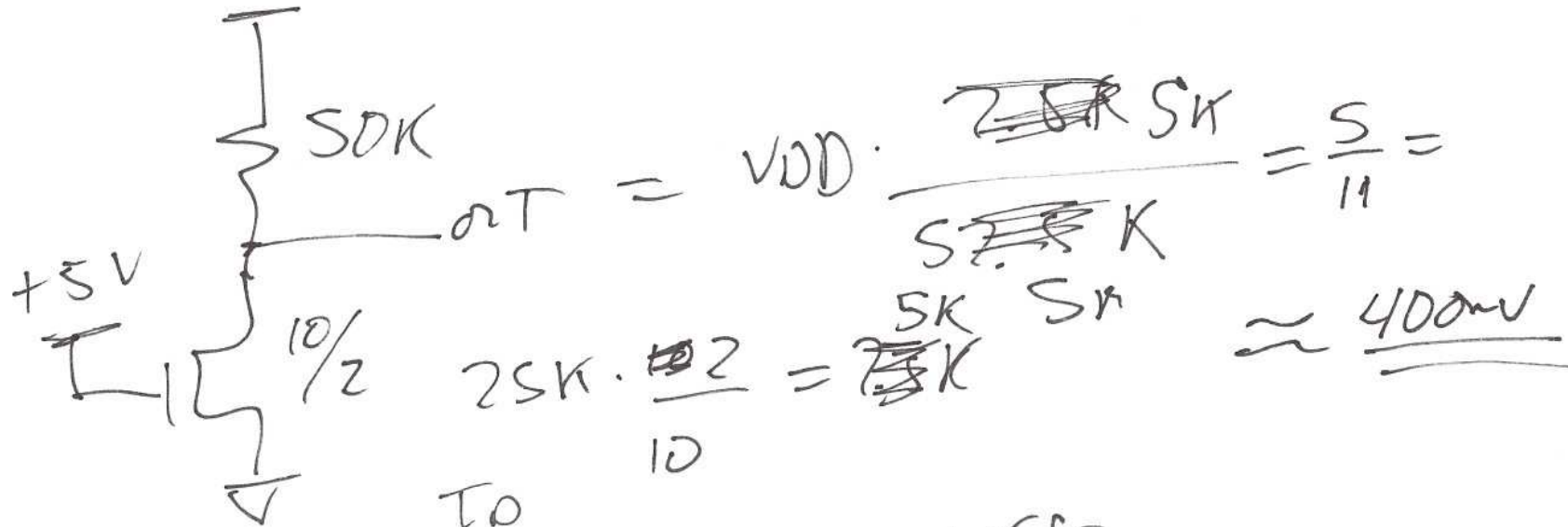


5)

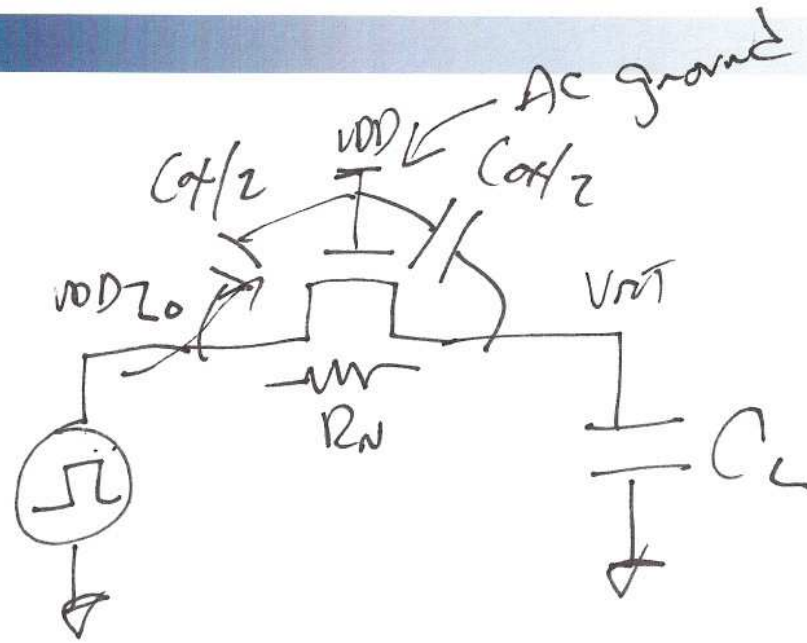
Sketch VTCs for



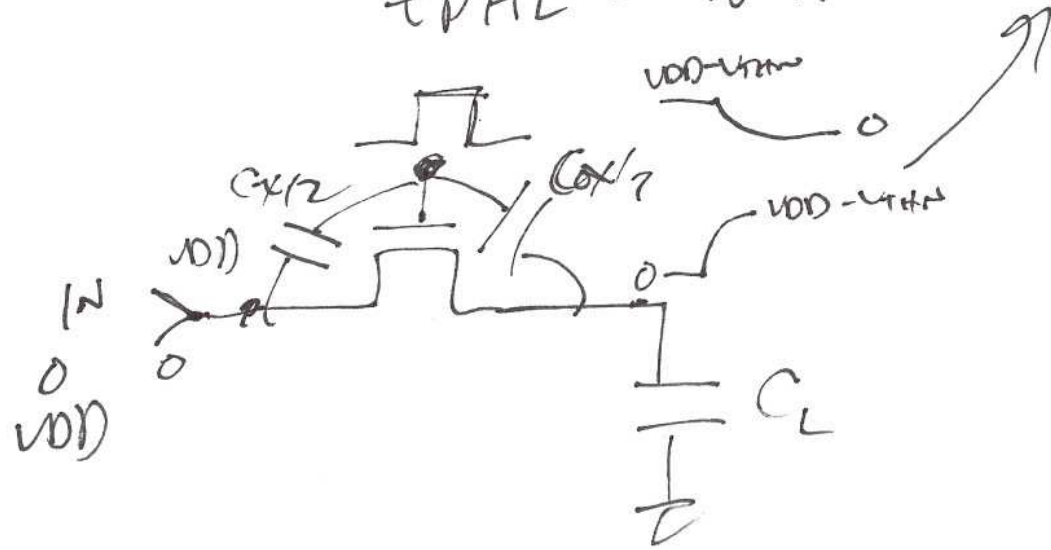
b)

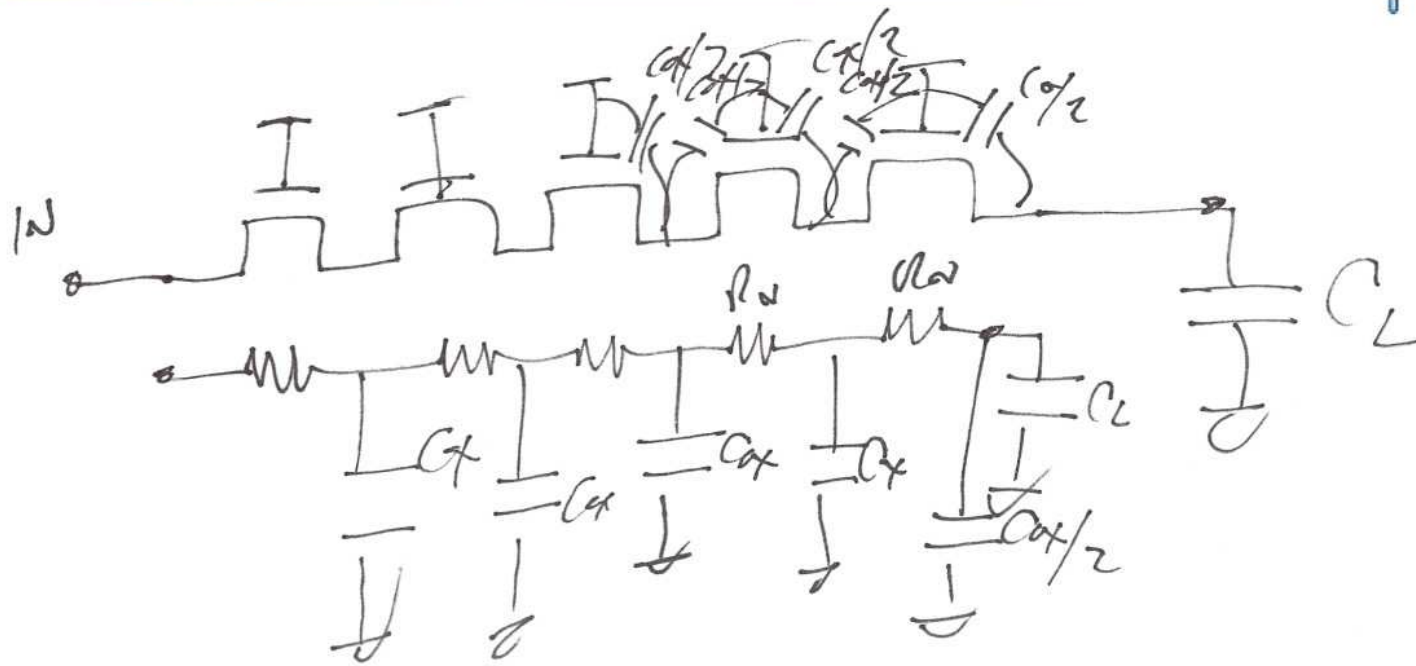


7)



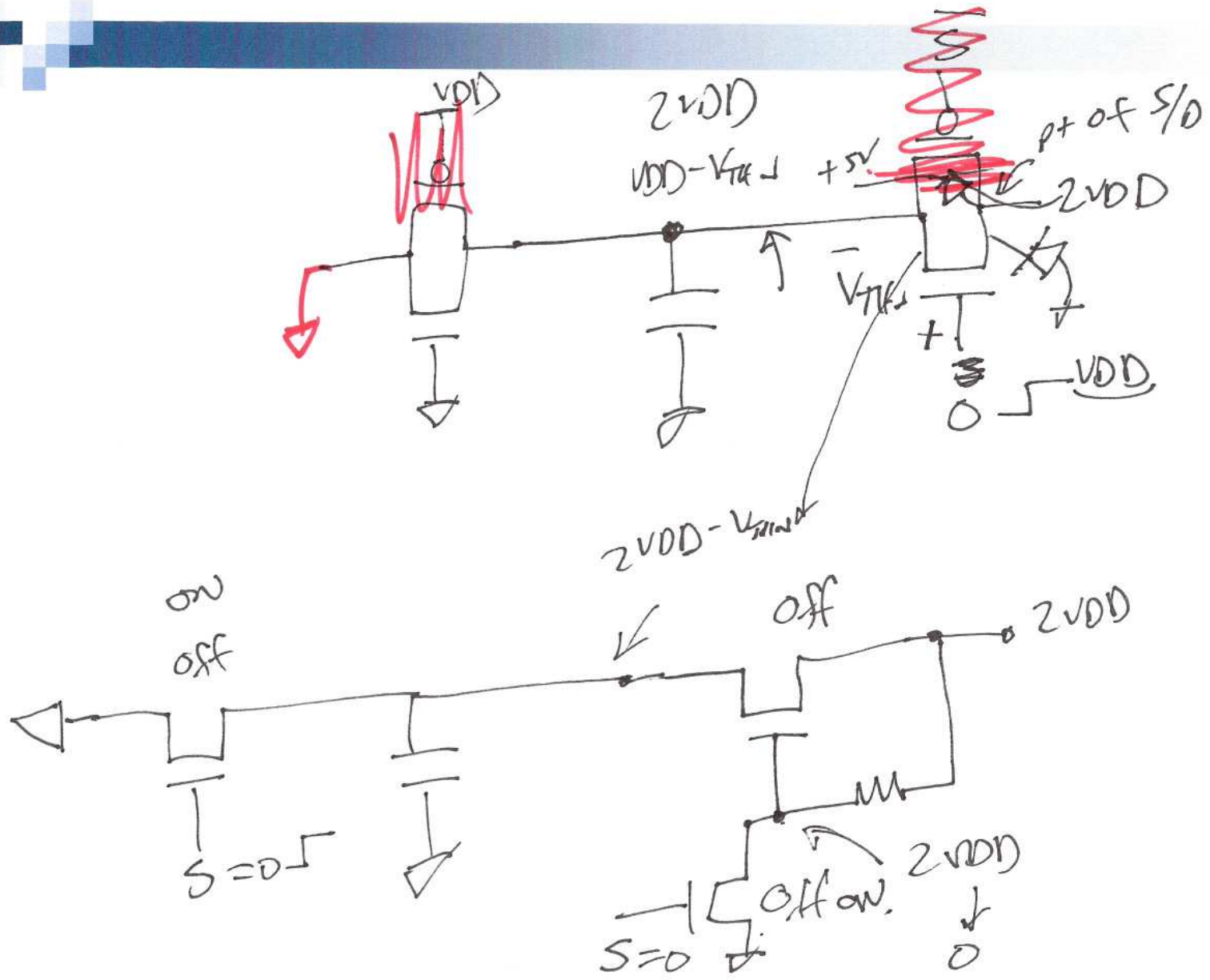
$$t_{pHL} = t_{pLH} = 0.7 R_{eq} \left( C_L + \frac{C_{ox}}{2} \right)$$





$$t_{pUH} = t_{pHL} = 0.35 R_w \cdot C_{ox} \cdot 5^2 + 5 \cdot R_w \cdot C_L \cdot 0.7$$

9)



$2V_{DD}$

$V_{DD} - V_{thn}$

$+5V$

pt of S/D of PMOS

of PMOS

well @  $+5$

$2V_{DD}$

$-V_{thn}$

$+V_{thp}$

$V_{DD}$

$2V_{DD} - V_{thn}$

on

off

off

$2V_{DD}$

$2V_{DD}$

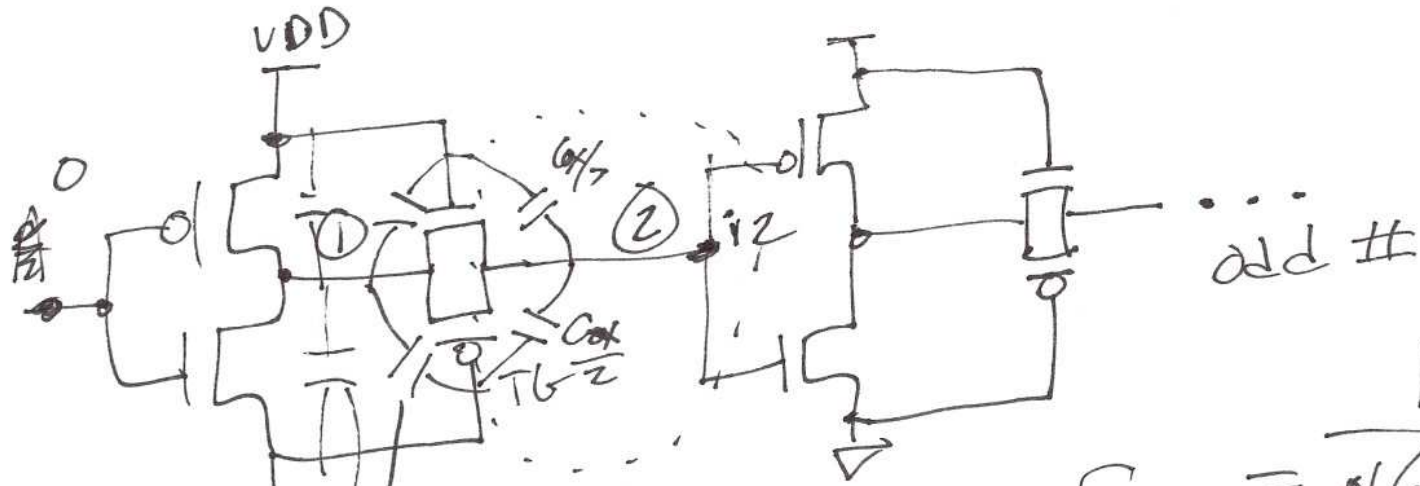
off on

$S=0$

$0$

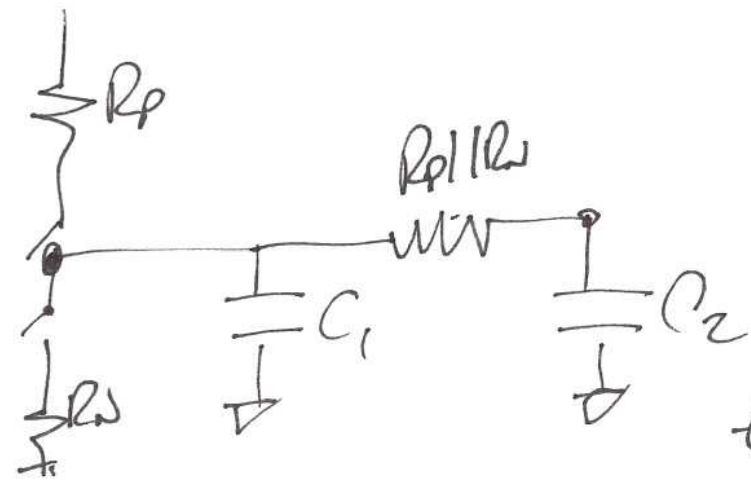
10)

# Ring OSC.



$$f_{osc} = \frac{1}{N(t_{PHL} + t_{PLH})}$$

$$C_1 = C_{ox} \left( W_{pL} L + W_{nL} L + \frac{W_{pL} L}{2} + \frac{W_{nL} L}{2} \right) + C_{ox} \left( \frac{3}{2} W_{pL} L + \frac{3}{2} W_{nL} L + \frac{W_{pL} L}{2} + \frac{W_{nL} L}{2} \right)$$

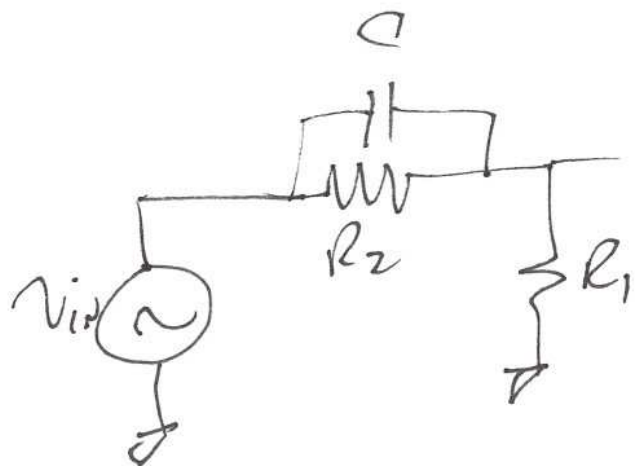
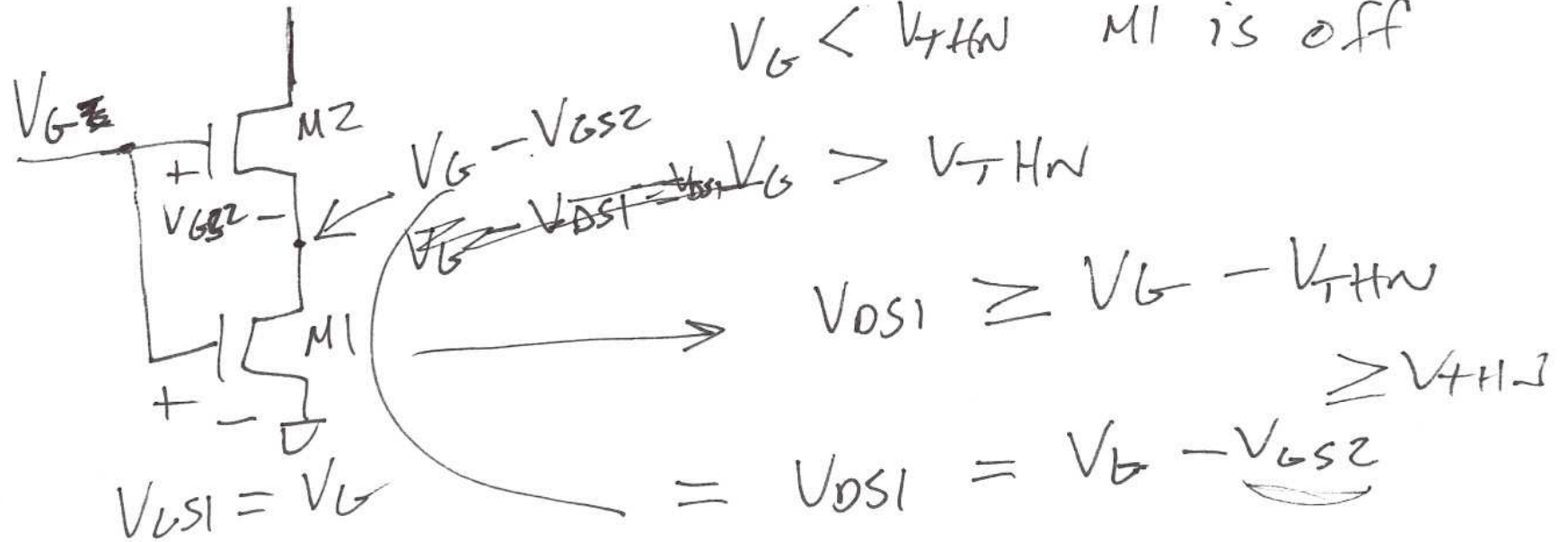


$$0 \rightarrow 2$$

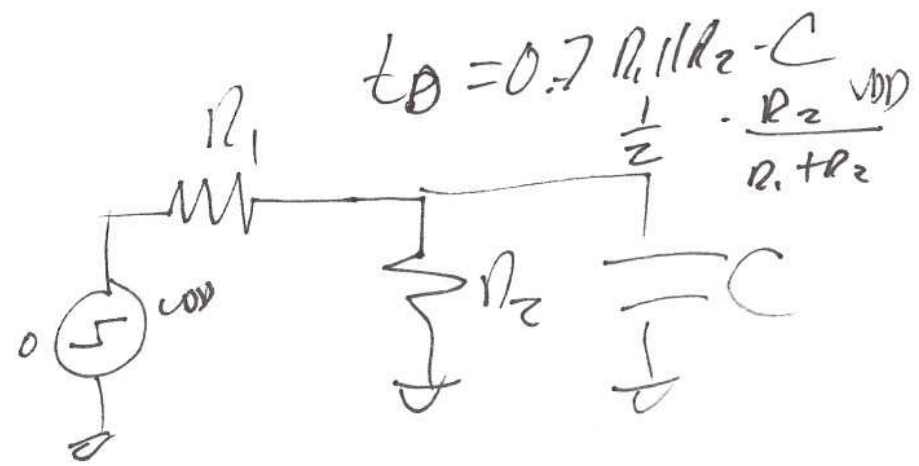
$$t_{PHL} = 0.7 R_n C_1 + 0.7 (R_n + R_p || R_n) C_2$$

$$t_{PLH} = 0.7 R_p C_1 + 0.7 (R_p + R_n || R_p) C_2$$

11)



$\omega \gg \frac{1}{RC}$

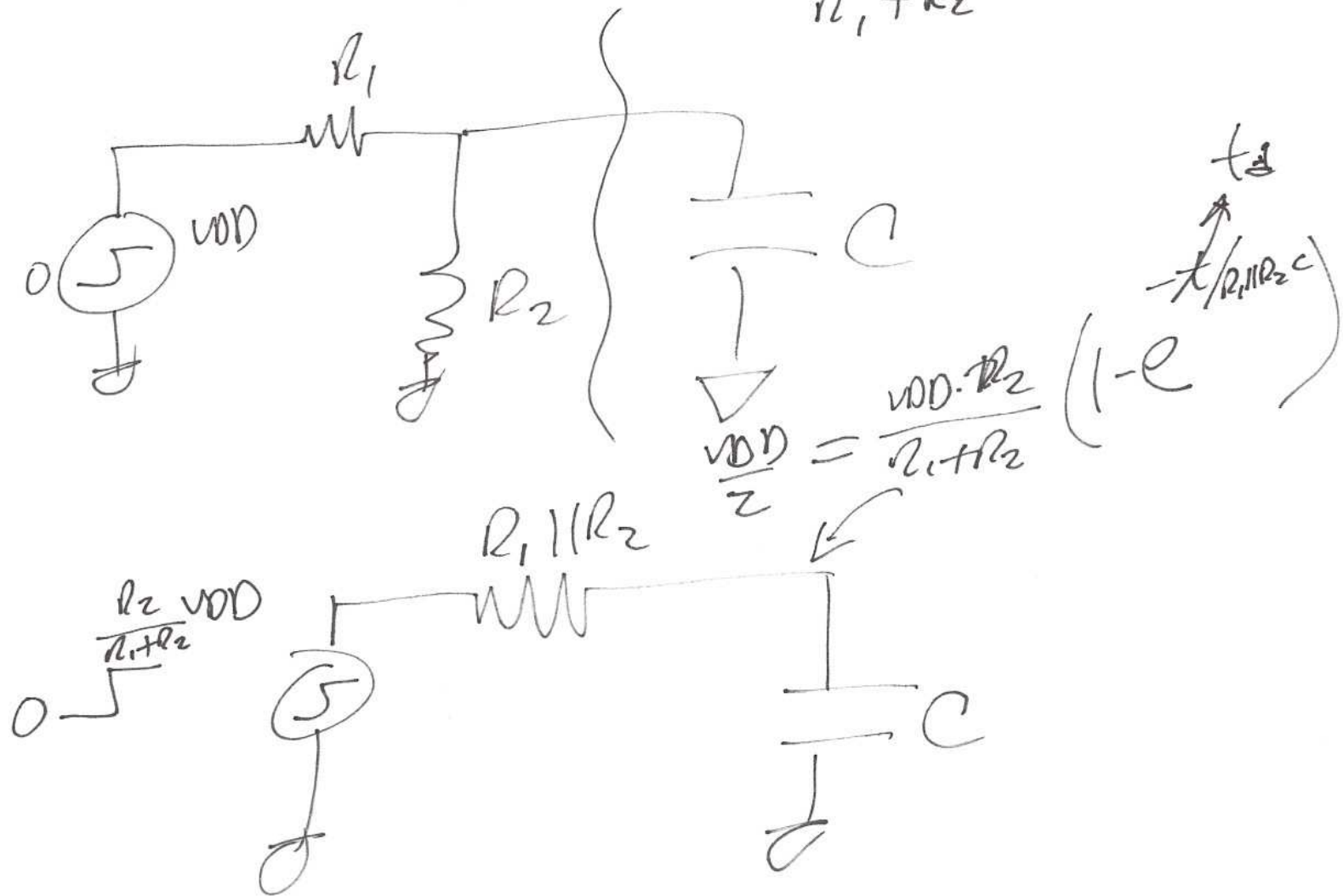


$t_D = 0.7 R_{eq} C$   
 $R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

(21)

50%  $\frac{v_{DD}}{2}$

$\frac{R_2}{R_1 + R_2} > \frac{1}{2}$



(13)