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

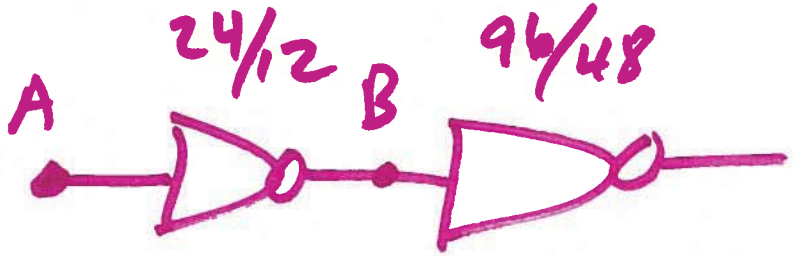
$R_p' = 40K$

$R_n' = 20K$

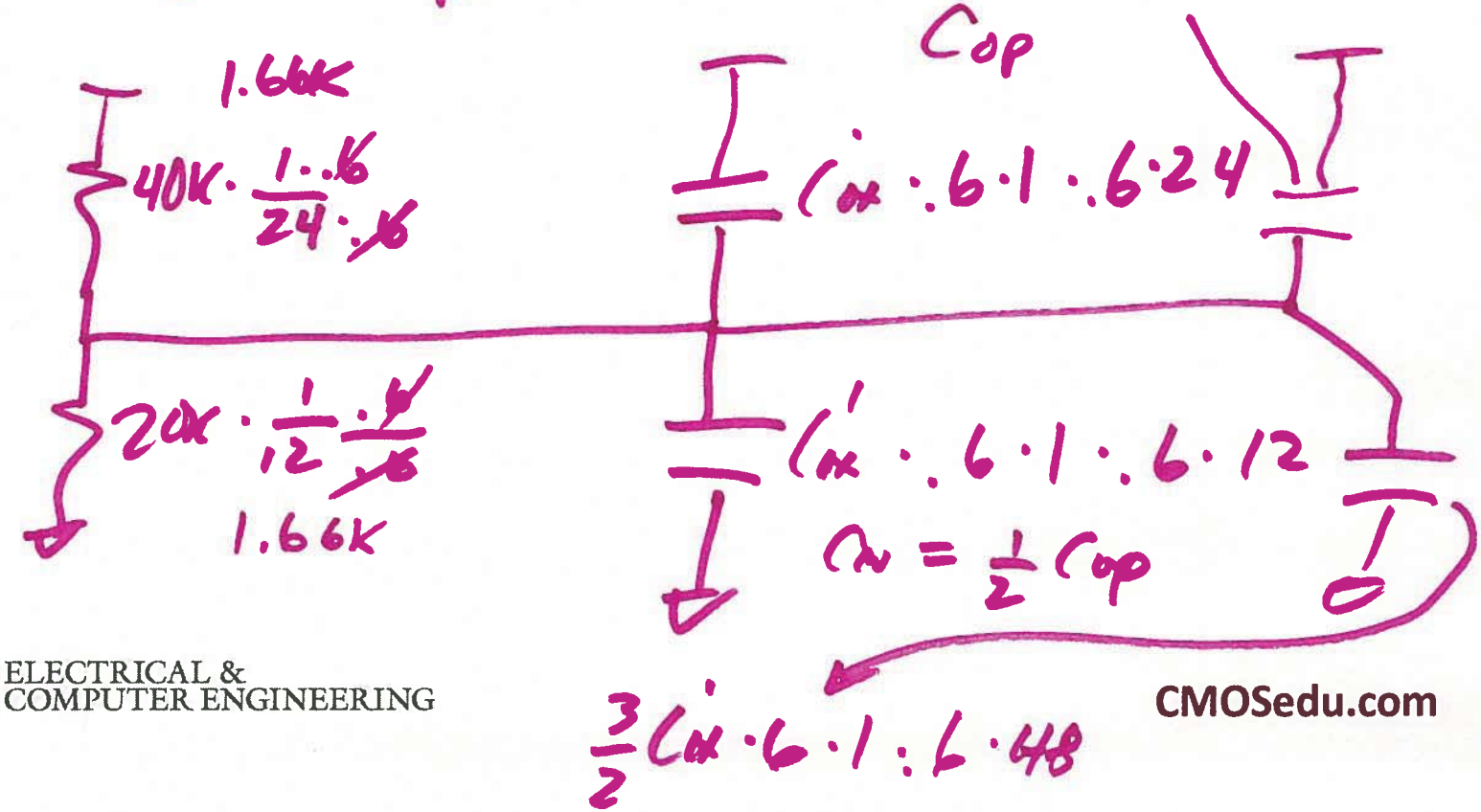
EE 421 / ECG 621

NOV. 15, 2017

Lecture 22



$\frac{3}{2} C_{ox}' \cdot .6 \cdot 1 \cdot .6 \cdot 96$



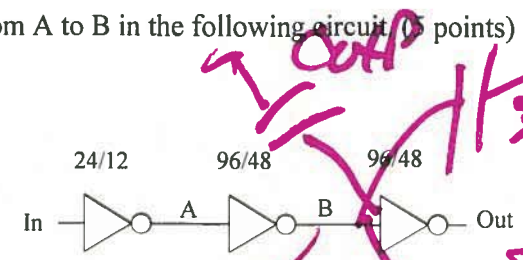
$\frac{3}{2} C_{ox}' \cdot .6 \cdot 1 \cdot .6 \cdot 48$

Quiz 12 – EE 421/ECG 621 Digital Electronics and Digital IC Design, Fall 2017

NAME:_____

Open book and closed notes.
Show your work for credit!
Assume the C5 process is used with lengths of 600 nm, $R'_n = 20k$, $R'_p = 40k$, and $C'ox = 2.5\ fF/um^2$

1. Estimate the delay from A to B in the following circuit (5 points)



C_{OXP} $\frac{3}{2}C_{OXP}$ $C'_{ox} \cdot .6 \cdot 1.6 \cdot .96$

C_{OXN} $\frac{3}{2}C_{OXN}$ $C'_{ox} \cdot .6 \cdot 1 \cdot .6 \cdot 48$

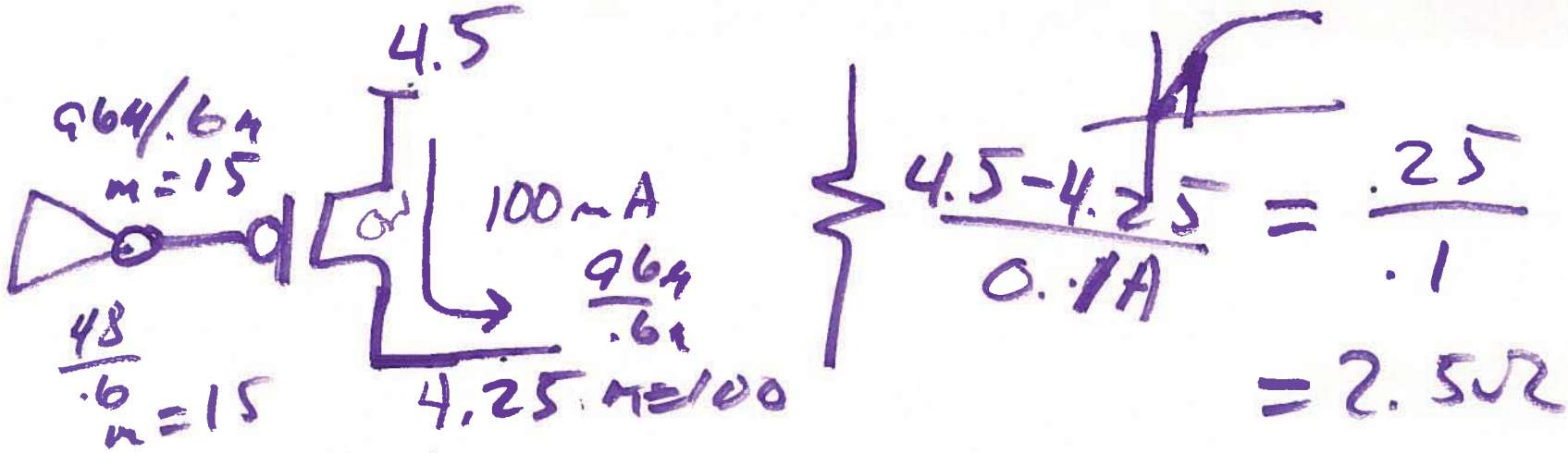
$40K \cdot \frac{.6 \cdot 1}{96 \cdot .6}$

$\frac{5}{2} \cdot C'_{ox} \cdot .6_{ox} \cdot .6_{ox} \cdot (96 \cdot 1 + 48 \cdot 1)$

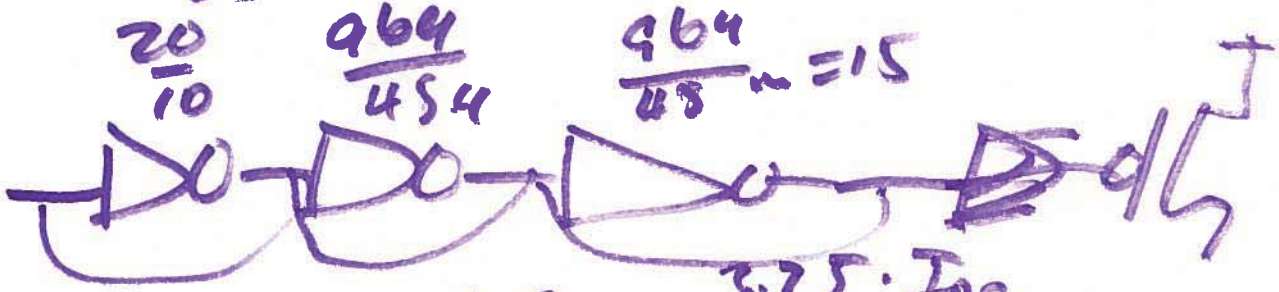
$20K \cdot \frac{1}{48}$

$t_{PHL} = 0.7 \frac{20K}{48} \cdot (\quad)$

2) $t_{PLH} = 0.7 \frac{40K}{96} (\quad)$

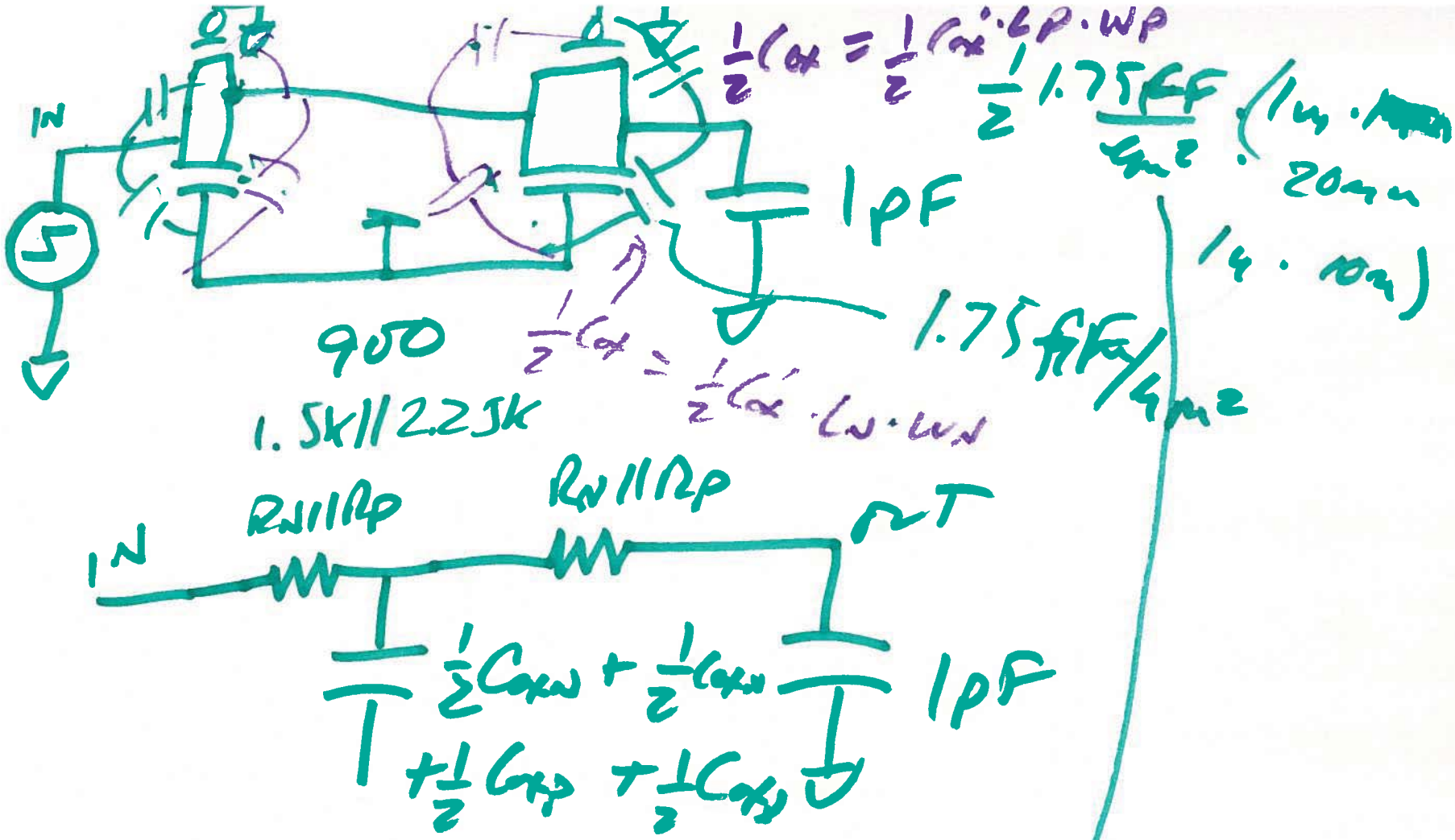


1A
1A

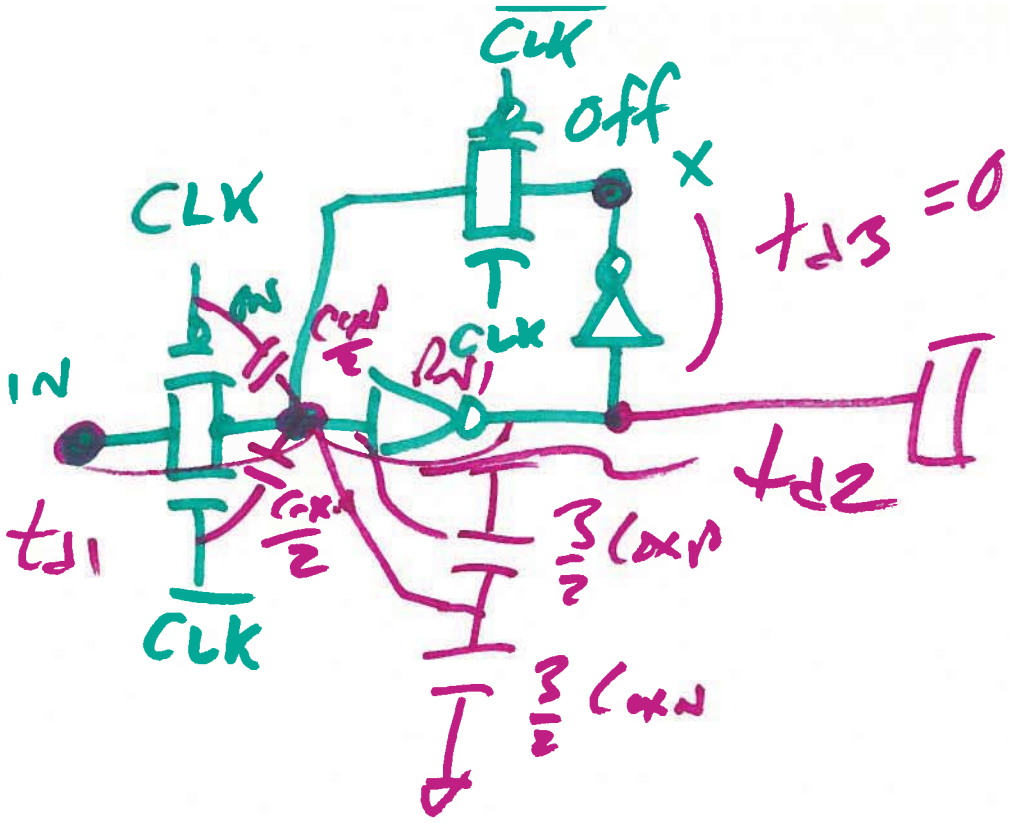


$$\%\varepsilon = \frac{3.75 \cdot I_{DC}}{VDD \cdot Rms\, I(VDD)}$$

3)



$$t_d = 0.7(900 + 900)\cdot(1pF + \quad)$$
$$+ 0.7\,900\cdot(C_{xp} + C_{xN})$$

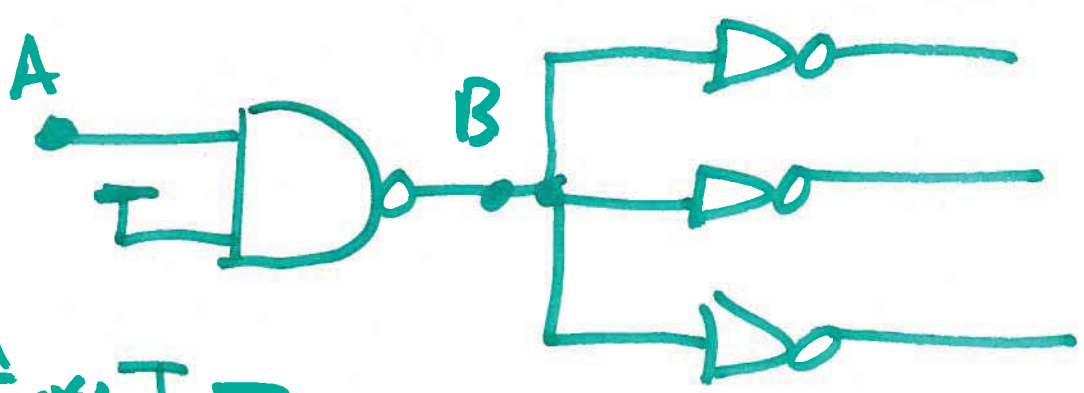


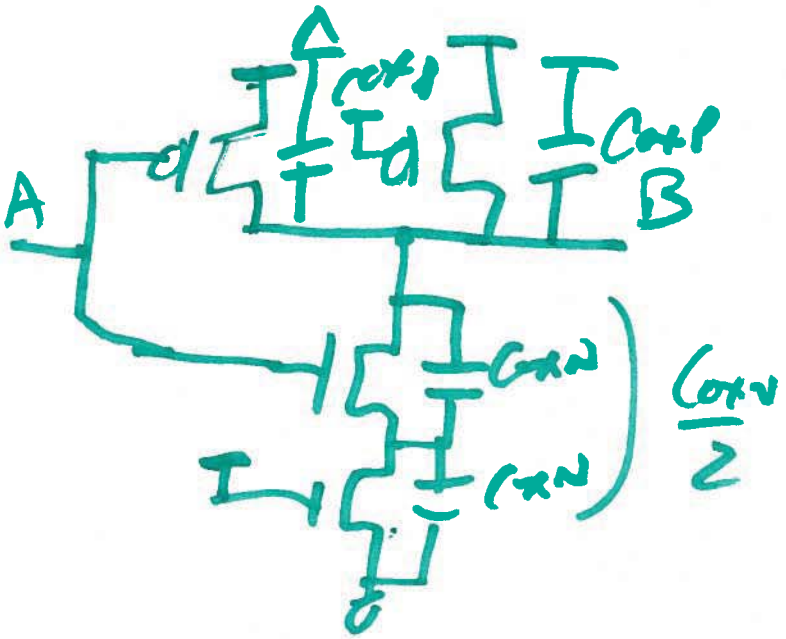
$$t_{d3} = 0.7 \frac{R_N}{R_D}\left(C_{oxN} + C_{oxp} + \frac{C_{oxN}}{2} + \frac{C_{oxp}}{2}\right)$$

$$t_{d1} = 0.7\, R_N \| R_p \cdot \left(\frac{C_{oxp}}{2} + \frac{C_{oxN}}{2} + \frac{3}{2}C_{oxp} + \frac{3}{2}C_{oxN}\right)$$

$$t_{d2}\Big|_{\substack{PHL \\ PLH}} = 0.7\, R_{N1} \cdot \left(C_{oxp} + C_{oxN} + \frac{3}{2}C_{oxp} + \frac{3}{2}C_{oxN} + \frac{C_{oxN}}{2} + \frac{C_{oxp}}{2}\right)$$

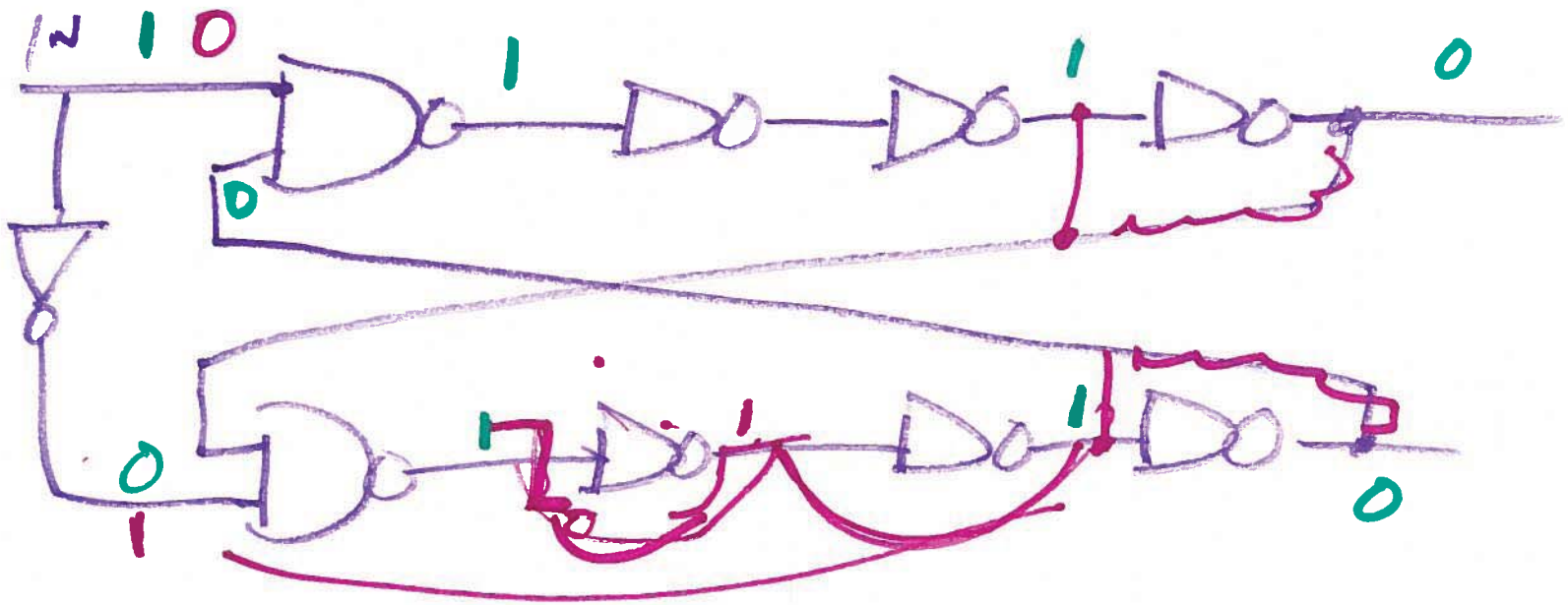
R_{N1} → R_{p1}





$$t_{pHL} = 0.7 \cdot 2 \cdot R_N \cdot \left(C_{drn} + C_{drn} + C_{load} + \frac{C_{drn}}{2} \right)$$

$$t_{pLH} = 0.7 \cdot R_p \cdot \left(2C_{drp} + \frac{C_{drn}}{2} + 3 \cdot \frac{3}{2} \left(C_{drp} + C_{drn} \right) \right)$$



$$t_{pHL} = 0.7 \cdot 2R_N \left(2C_{xp} + \frac{C_{xN}}{2} + \frac{3}{2}\left(C_{xN} + \frac{3}{2}C_{xp}\right)\right)$$

$$+ \; \tfrac{3}{2} \cdot 0.7 R_p \cdot \left(C_{xp} + C_{xN} + \frac{3}{2}C_{x1} + \frac{3}{2}C_{xN} \right)$$

$$0.7 R_N \left(\right.$$