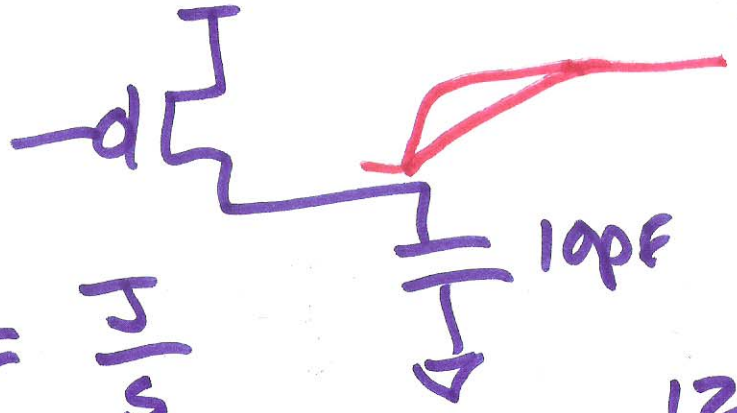
EE 421 / ECE 621

NOV. 18, 2013

Lecture 22



$f = 100\ MHz$, $T = 10NS$

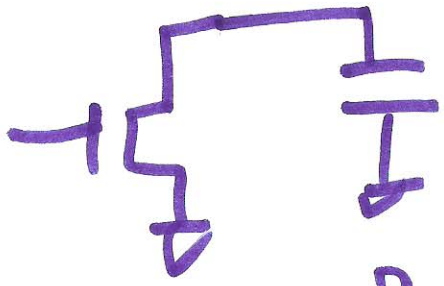
$$\varepsilon = \frac{1}{2}CV^2$$

$$= \frac{1}{2} \cdot 10pF \cdot 25$$

$$= 125\ pJ$$

$$W = \frac{J}{s}$$

$$P_{Pmos} = \frac{125pJ}{10ns} = \underline{125\ pJ}$$

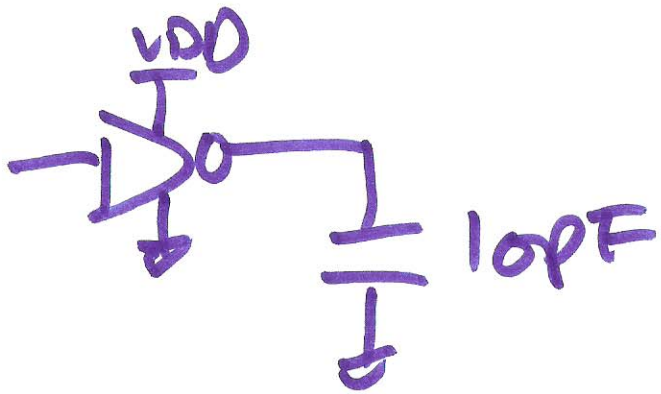


$$= \underline{12.5\ mW}$$

$$P_{Nmos} = \frac{125pJ}{10ns} = \underline{12.5\ mW}$$

$$P_{TOT} = 25\ mW$$

1)



$T = 10ns$

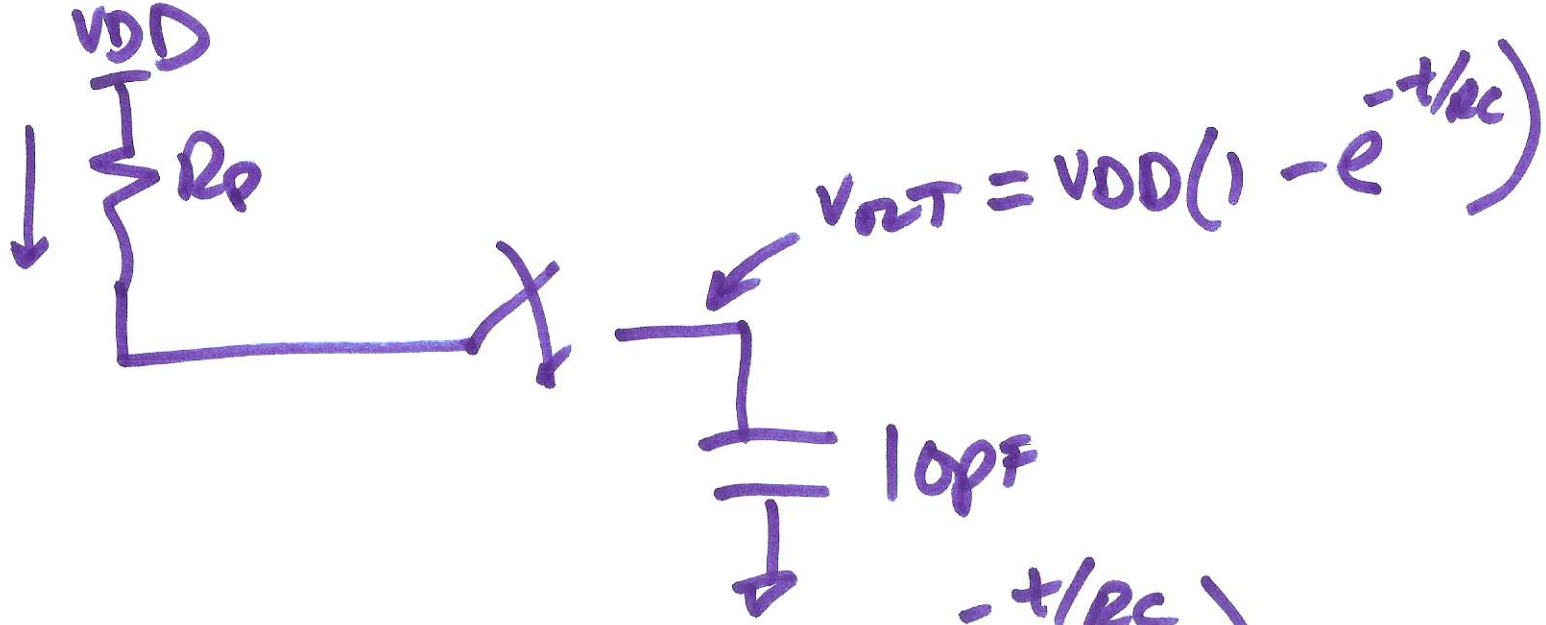
$Q = VDD \cdot 10pF$

$= 50pC$

$I_{AVG} = \frac{50pC}{10ns} = 5mA$

$P_{AVG} = 5 \cdot 5mA$

$= 25mW$



$$I = \frac{VDD - VDD(1 - e^{-t/RC})}{R_P}$$

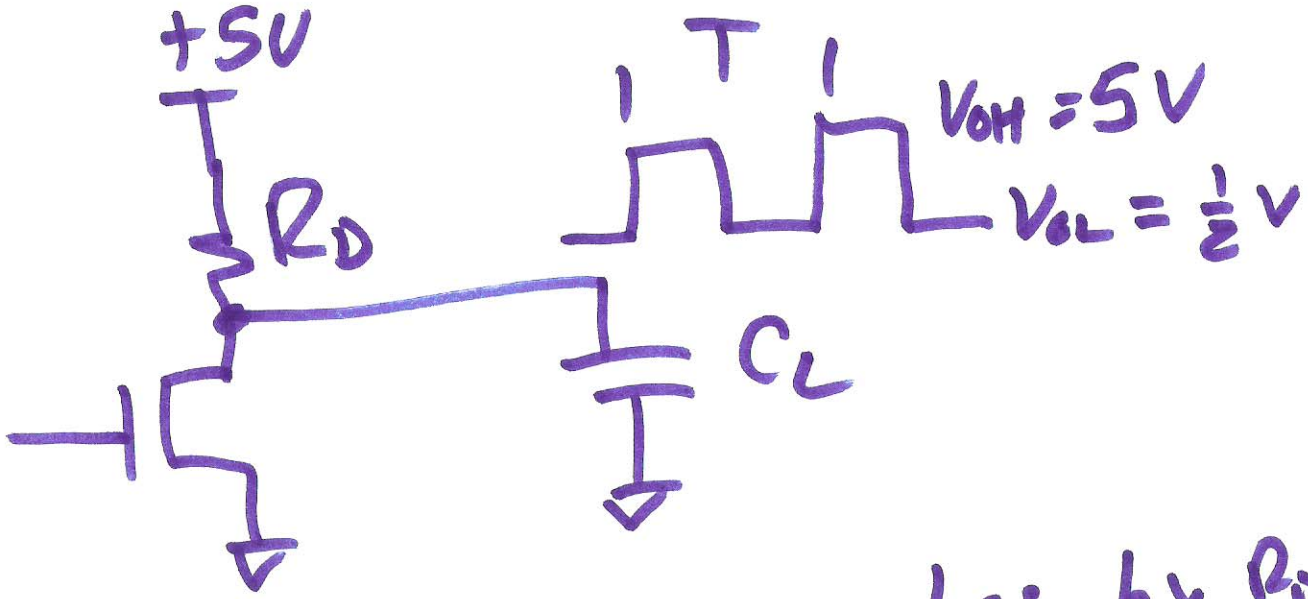
$$I = \frac{VDD}{R} e^{-t/RC}$$

$$\int_0^\infty I \cdot dt = Q = \int_0^\infty \frac{VDD}{R} e^{-t/RC} dt = \frac{VDD}{R}(-RC)\left(e^{-t/RC}\right)\Big|_0^\infty$$

$$(0-1)$$

$$Q = VDD \cdot C$$

3)



How much power dies by R_D?

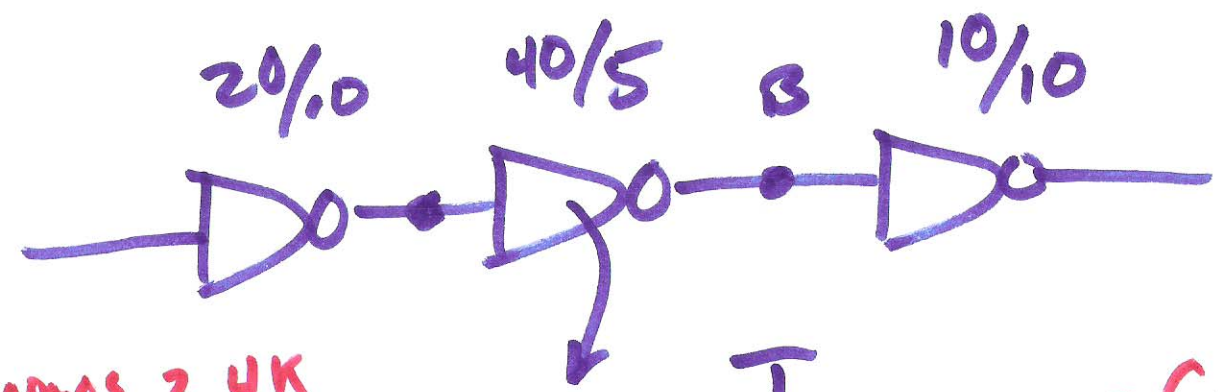
$$E = \frac{1}{2} C_L \cdot VDD^2 \qquad P = \frac{E}{T}$$

$$E = \frac{1}{2} C_L \left(VDD - \frac{1}{2}\right)^2$$

$$I_{AVG} = \frac{C_L \cdot VDD}{2T}, \quad P = I_{AVG} \cdot VDD$$

Study this ii

$$P = \frac{\frac{1}{2}\left(5 - \frac{1}{2}\right)^2 T}{R_D} \cdot \frac{1}{T} = \frac{1}{2}\left(\frac{5 - \frac{1}{2}}{R_D}\right)\left(5 - \frac{1}{2}\right)$$



$\frac{10}{1}$ nmos 3.4K

$\frac{20}{1}$ pmos 3.4K

$C_{oxp}|_{\frac{20}{1}} = 1.25fF$

$C_{oxN}|_{\frac{10}{1}} = 625aF$

R_P 1.7K

R_N 6.8K

$C_{ovTP} = C_{oxp}$ 2.5fF

$C_{ovTN} = C_{oxN}$ 312.5aF

0.313 ff

$C_{in} = \frac{3}{2}C_{oxN} + \frac{3}{2}C_{oxp}$

$\frac{3}{2} \cdot 625aF + \frac{3}{2} 625aF$

C_{oxN} C_{oxP}

$t_{pLH} = 0.7 \cdot 1.7K(4.7fF)$

$t_{pHL} = 0.7 \cdot 6.8K(4.7fF)$

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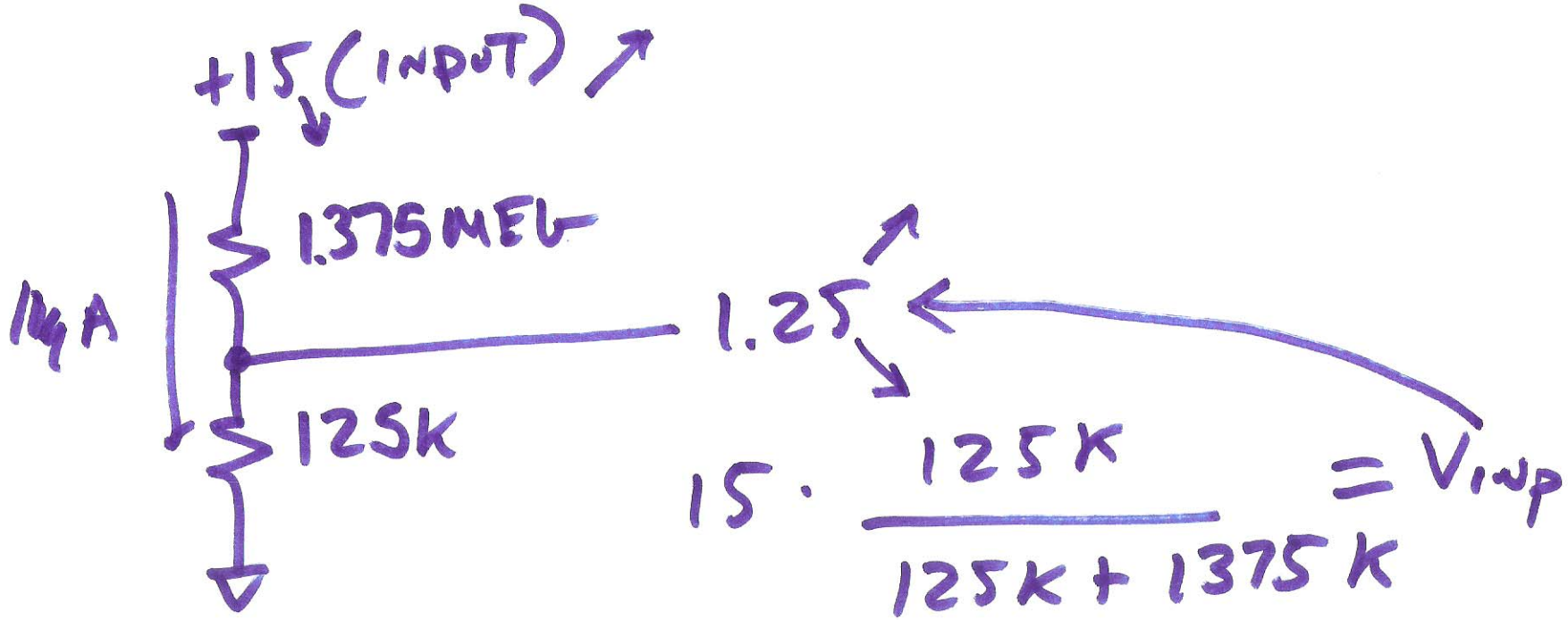
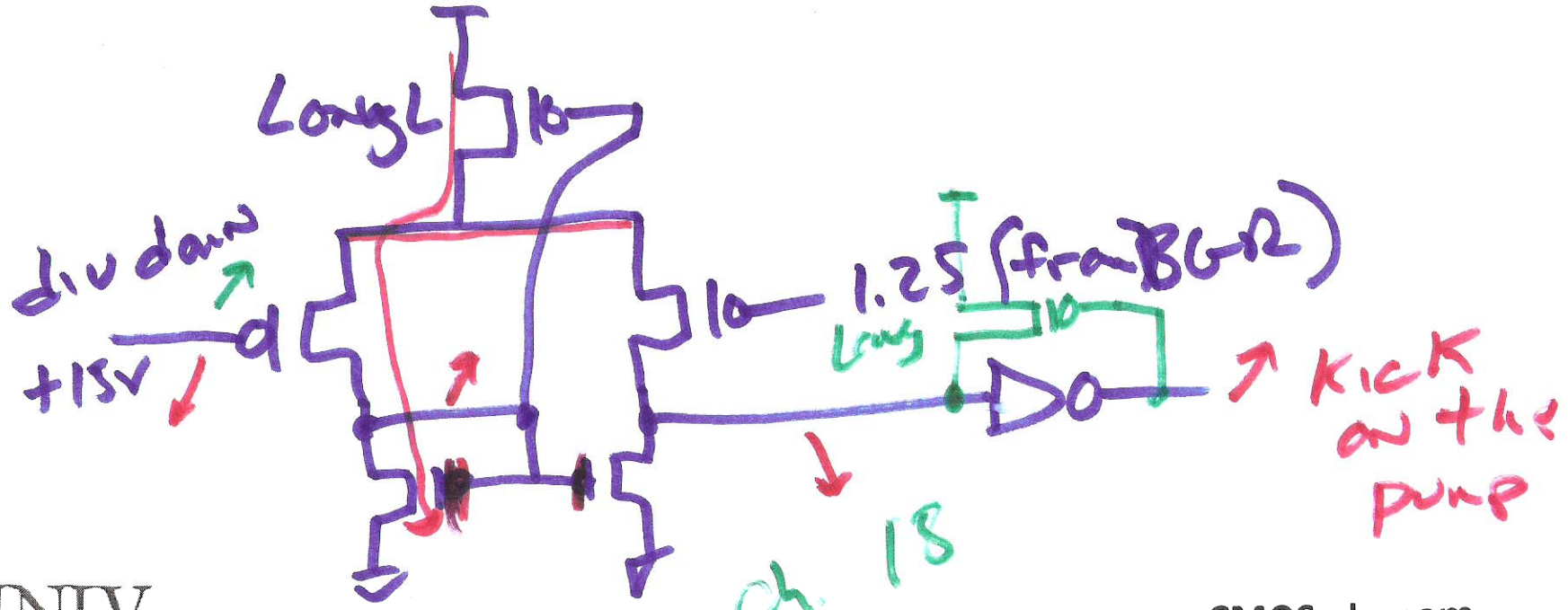
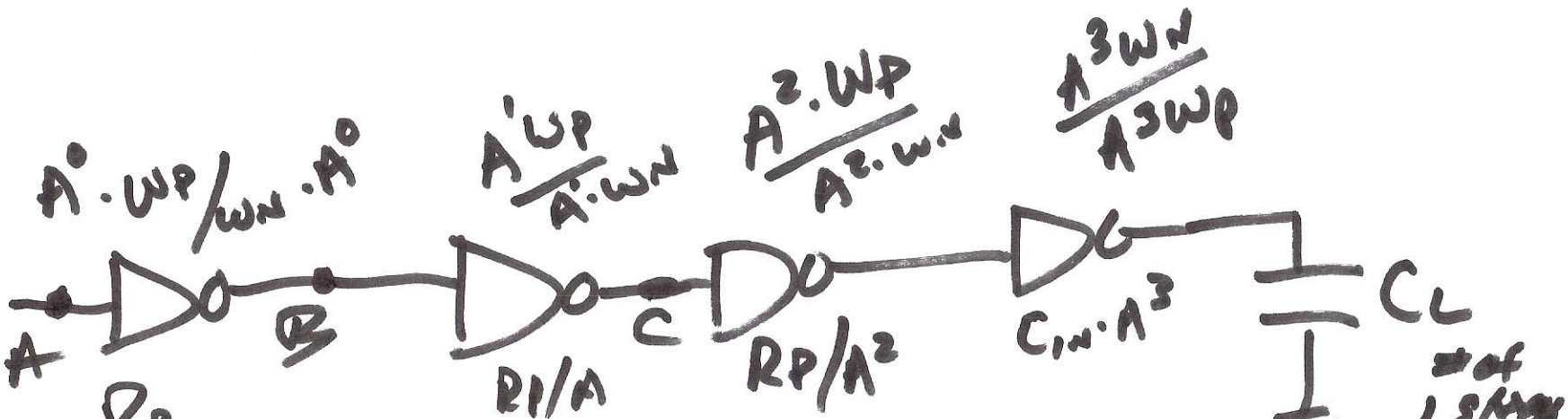
5)


+15 (INPUT)
1.375 MEG
1μA
1.25
125K
$15 \cdot \frac{125K}{125K + 1375K} = V_{inp}$


Long L
10
div down
+15V
10
1.25 (from BG ref)
Long
10
kick on the pump
ch. 18



$$t_{pLH}\Big|_{A3} = R_p \cdot 0.7 \cdot \left[C_{OUT} + A C_{IJ}\right]$$

$$\Big|_{BC} = \frac{R_p}{A} \cdot 0.7 \left[C_{OUT} \cdot A + A^2 \cdot C_{IN}\right]$$

$$t_{PHL} + t_{PLH} = 0.7 \sum_{K=1}^{N} (R_{n1} + R_{p1})(C_{DBT1} + AC_{in1})$$

$$0 = \frac{\delta t_{PHL} + t_{PLH}}{\delta N} \equiv \frac{\delta 0.7 \cdot N (R_{n1} + R_{p1})(C_{DBT1} + AC_{in1})}{\delta N}$$

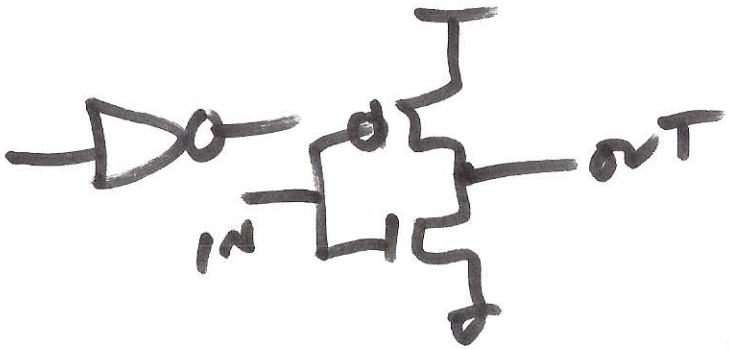
$$\left(\frac{C_L}{C_{in1}}\right)^{1/N}$$

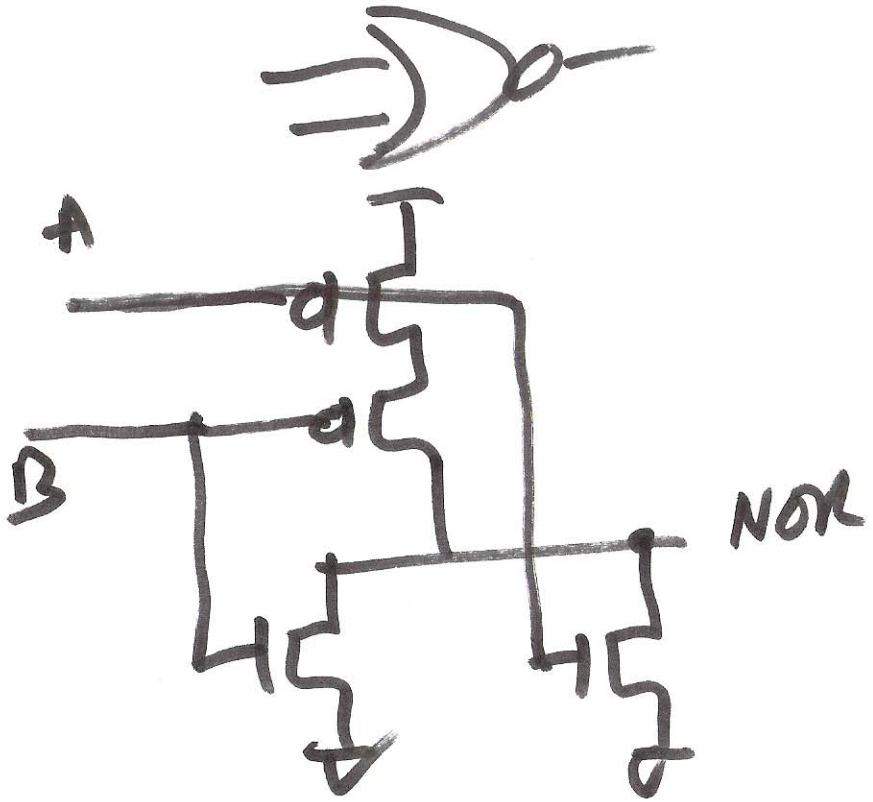
$$N = \ln \frac{C_{load}}{C_{in1}}$$

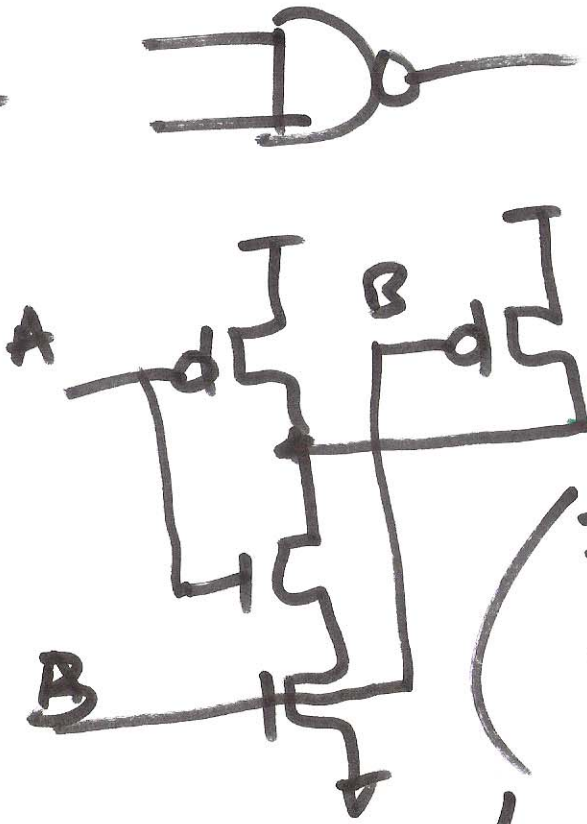
$$A = e = 2.718$$

$$A = 8$$

Logic gates







$t_{PLH} = 0.7 \frac{R_p \cdot C_L}{2}$

A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

$t_{PHL} = 0.7(2R_n)C_L$

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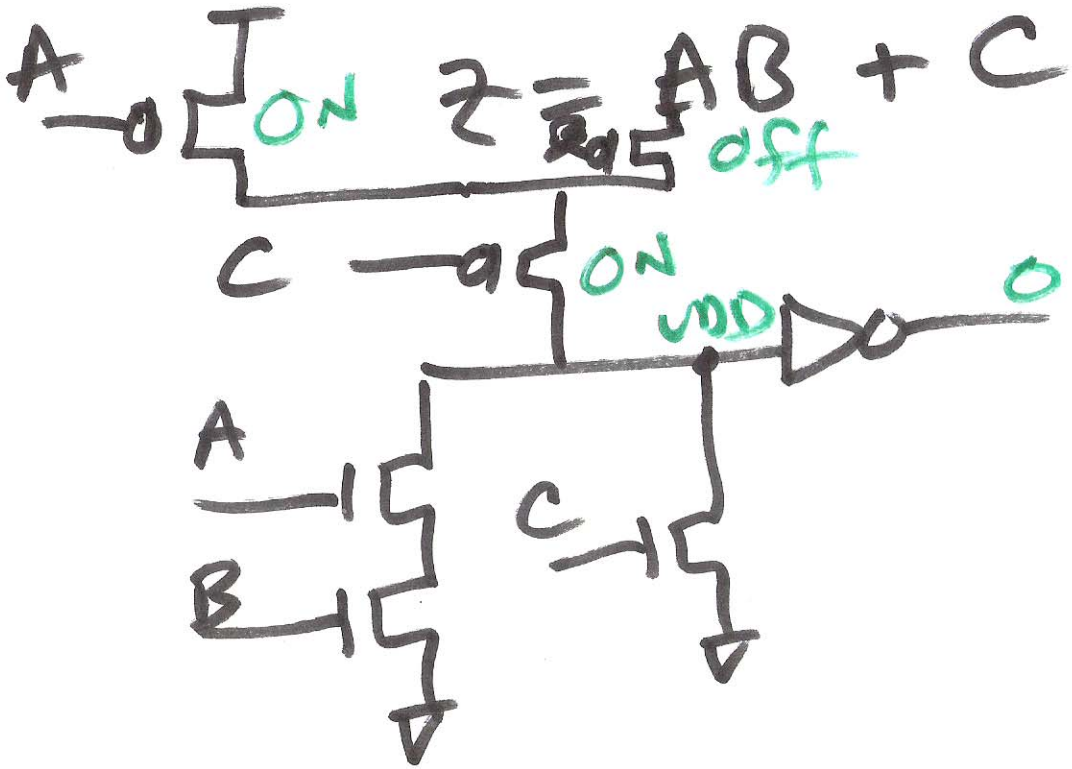
Complex gates



A = 0

B = 1

C = 0