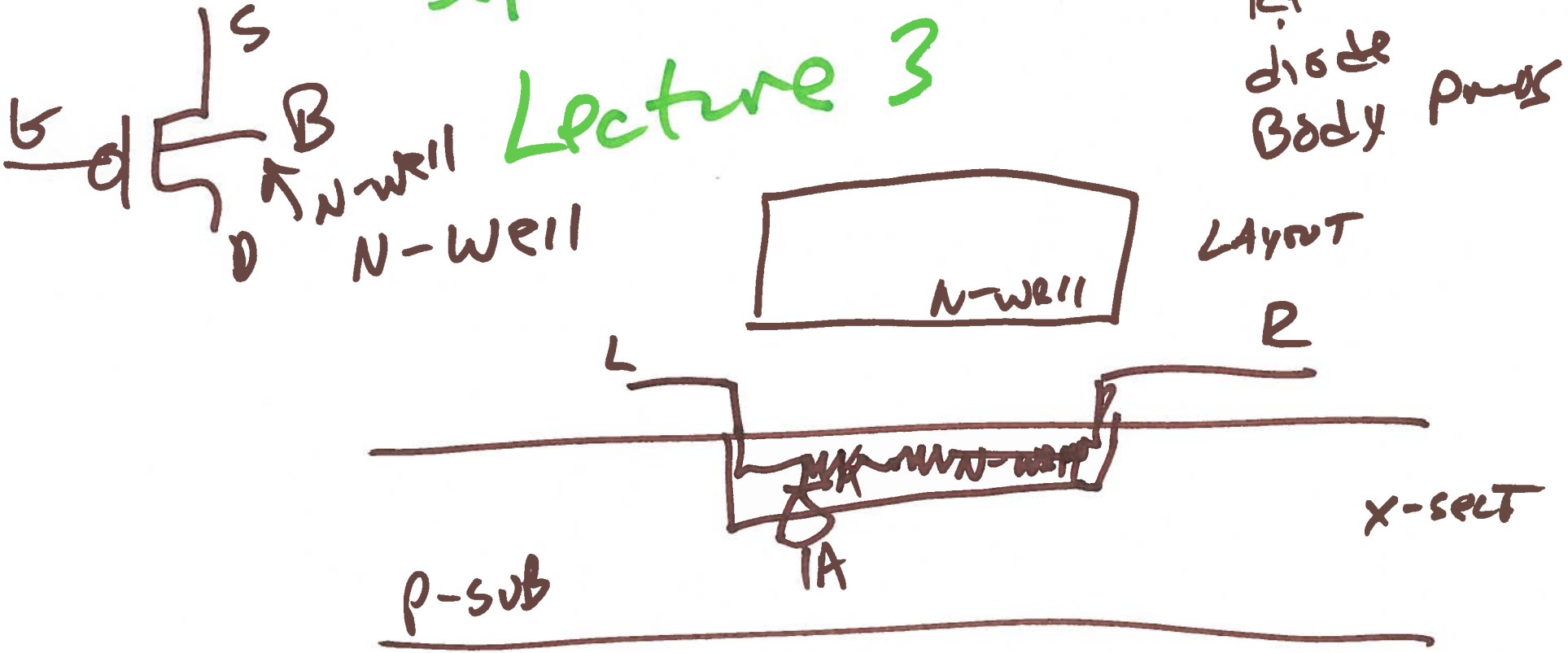
EE421/ECG621

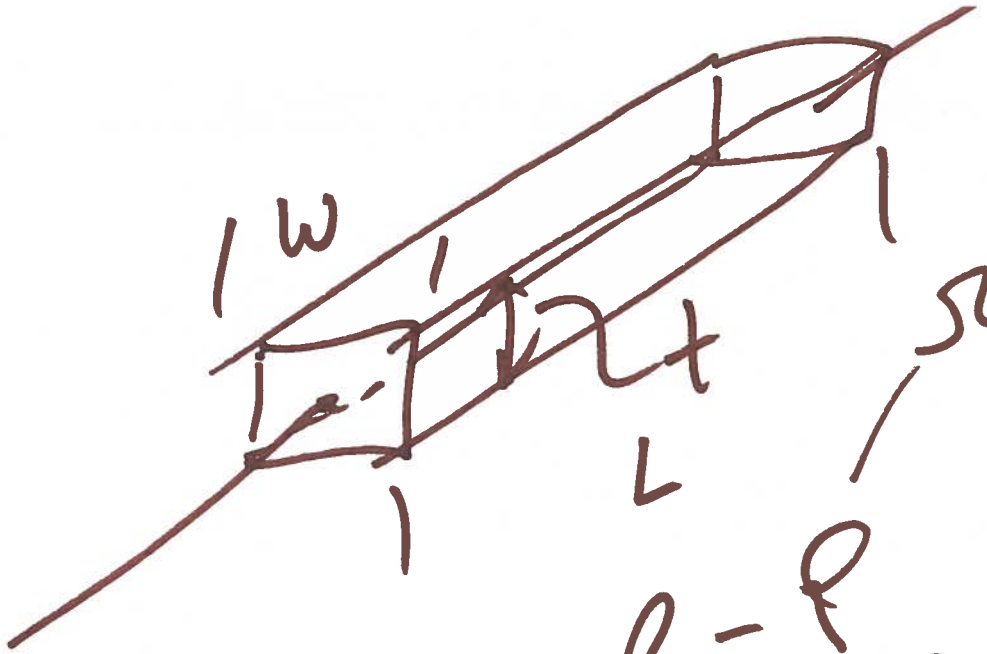
CMOS Digital IC Design

September 7, 2016

Lecture 3



Resistor diode Body pmos

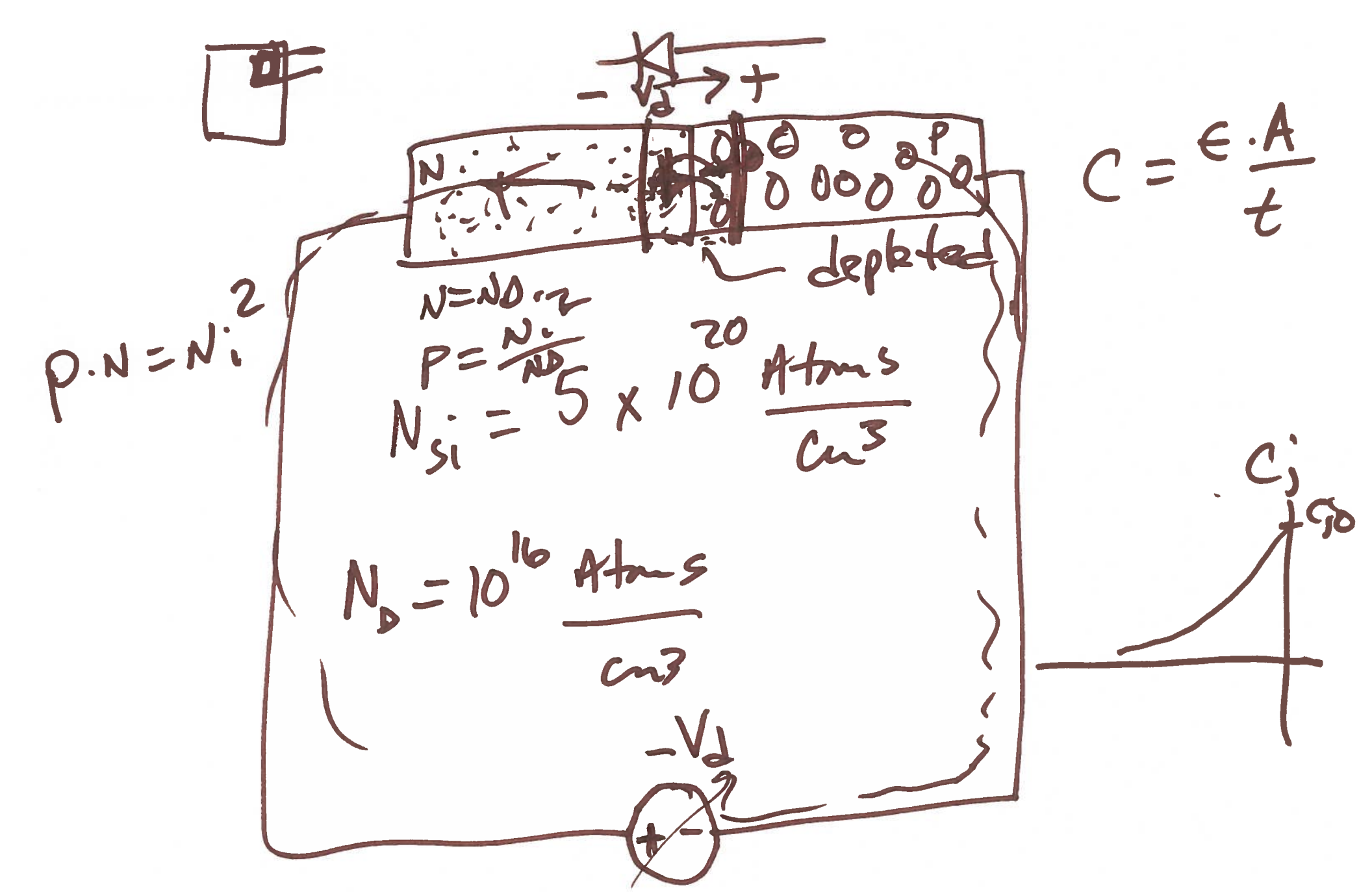


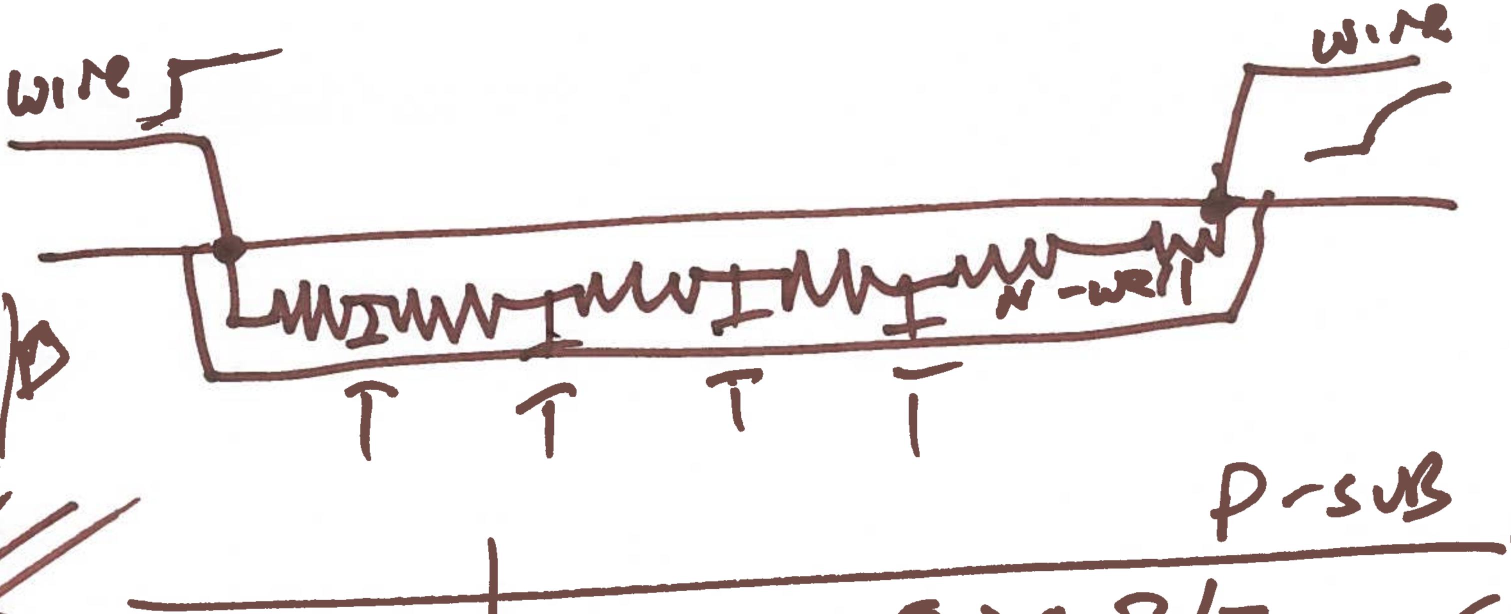
ρ , $\Omega \cdot cm$

$$R = \underbrace{\frac{\rho}{t}} \cdot \frac{L}{W}$$

sheet resistance $\frac{\Omega}{\square}$

$L = W$


$C = \epsilon \cdot \frac{A}{t}$
$p \cdot N = N_i^2$
$N = N_D$
$P = \frac{N_i^2}{N_D}$
$N_{Si} = 5 \times 10^{20} \frac{Atoms}{cm^3}$
$N_D = 10^{16} \frac{Atoms}{cm^3}$
depleted
$-V_d$
C_j
C_{j0}



900fF/□

~~900fF~~
~~900fF~~

# of squares CS

$R_{\square}\Big|_{N\text{-well}} = 800\,\Omega/\square$

$\frac{600}{3} = 200$ squares

$C_{dpp} = 100\,aF/\mu m^2$

$100aF \cdot 9\mu m^2$

atto

$a = 10^{-18}$

$f = 10^{-15}$

$p = 10^{-12}$

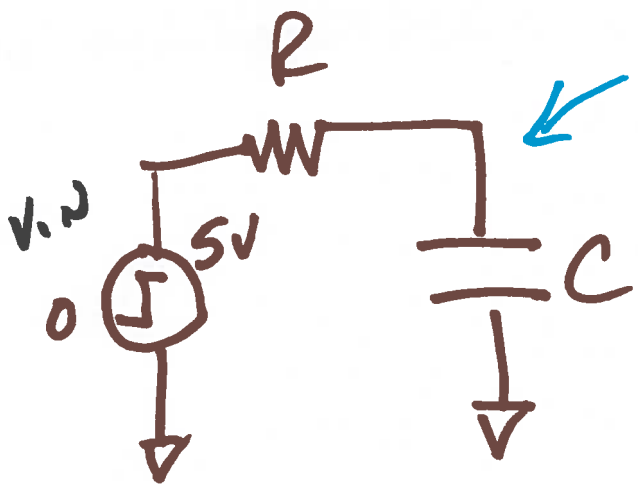
$\mu = 10^{-6}$

$\mu m = 10^{-6}\,m$

$R = 800\frac{\Omega}{\square}\ 200\square$

$= 160K$

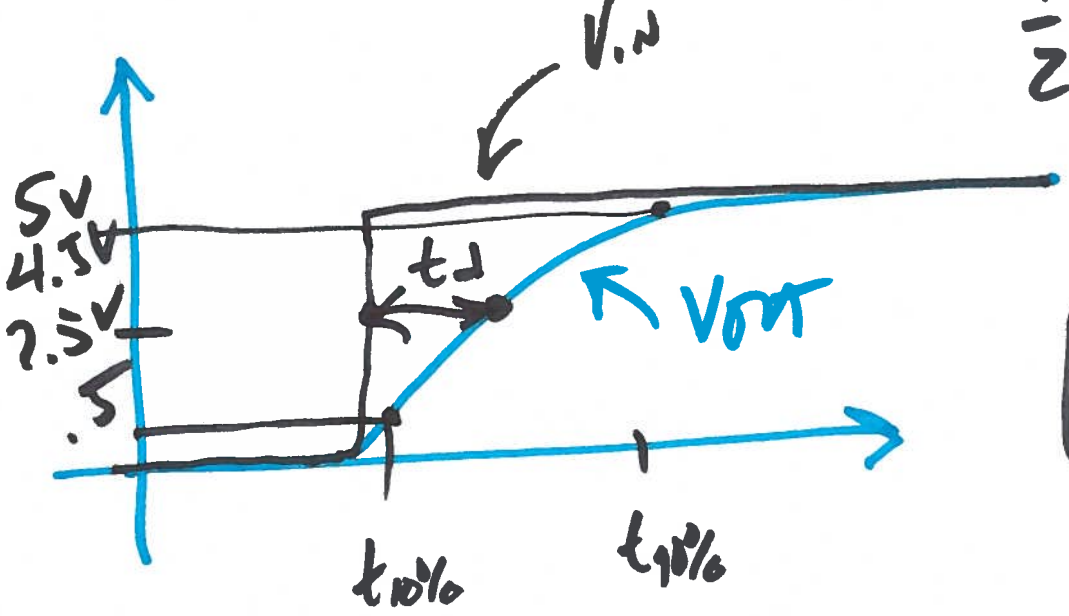
4)



$$V_{OUT} = V_p\left(1 - e^{-t/RC}\right)$$

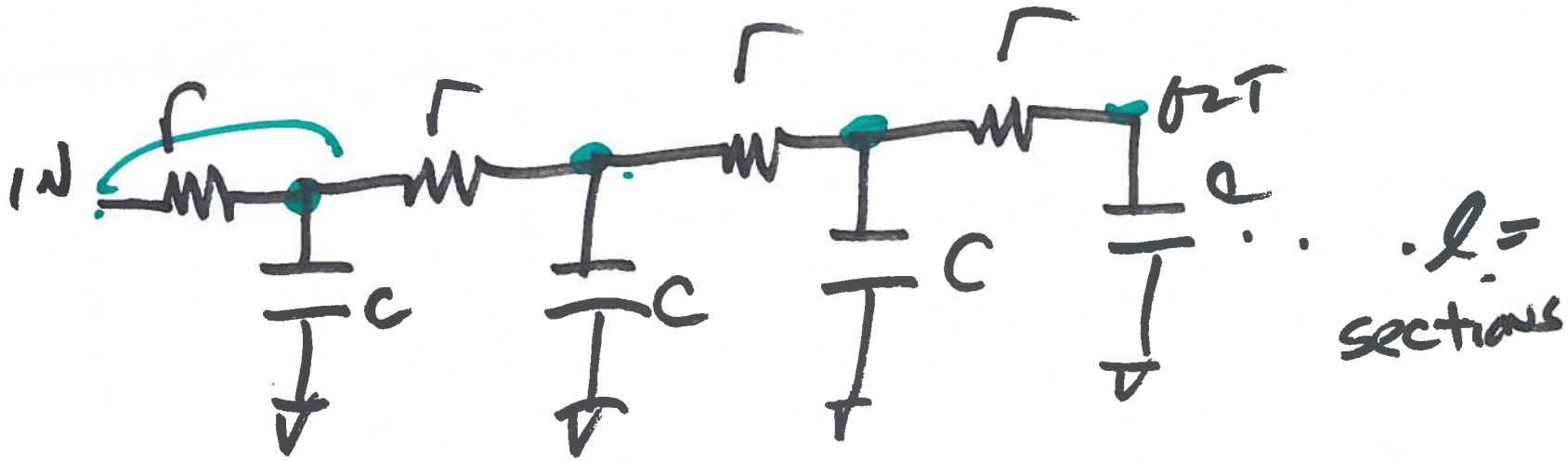
$$\frac{V_p}{2} = V_p\left(1 - e^{-t_d/RC}\right)$$

$$\frac{1}{2} = e^{-t_d/RC}$$



$$t_d = -RC \ln \frac{1}{2}$$

$$\boxed{t_d = 0.7RC}$$



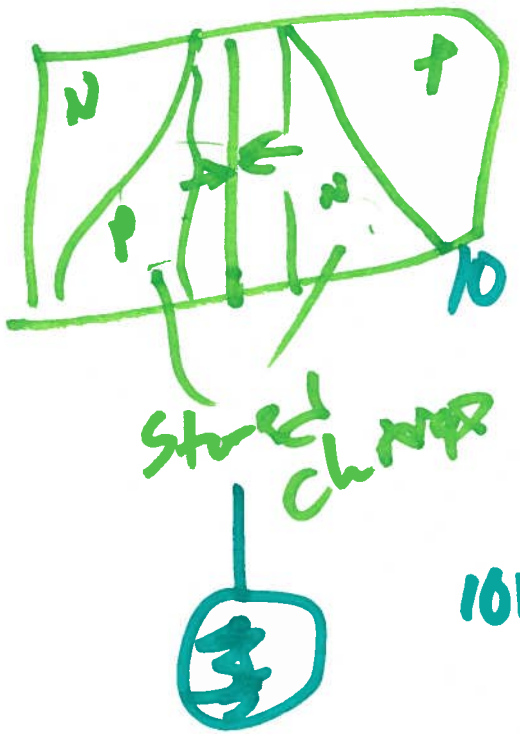
$$t_1 = 0.7rC + 0.7 \cdot 2rC + \dots$$

$$t_2 = 0.7 \cdot \frac{l^2}{2} \cdot rC \qquad 0.73rC + 0.74rC$$

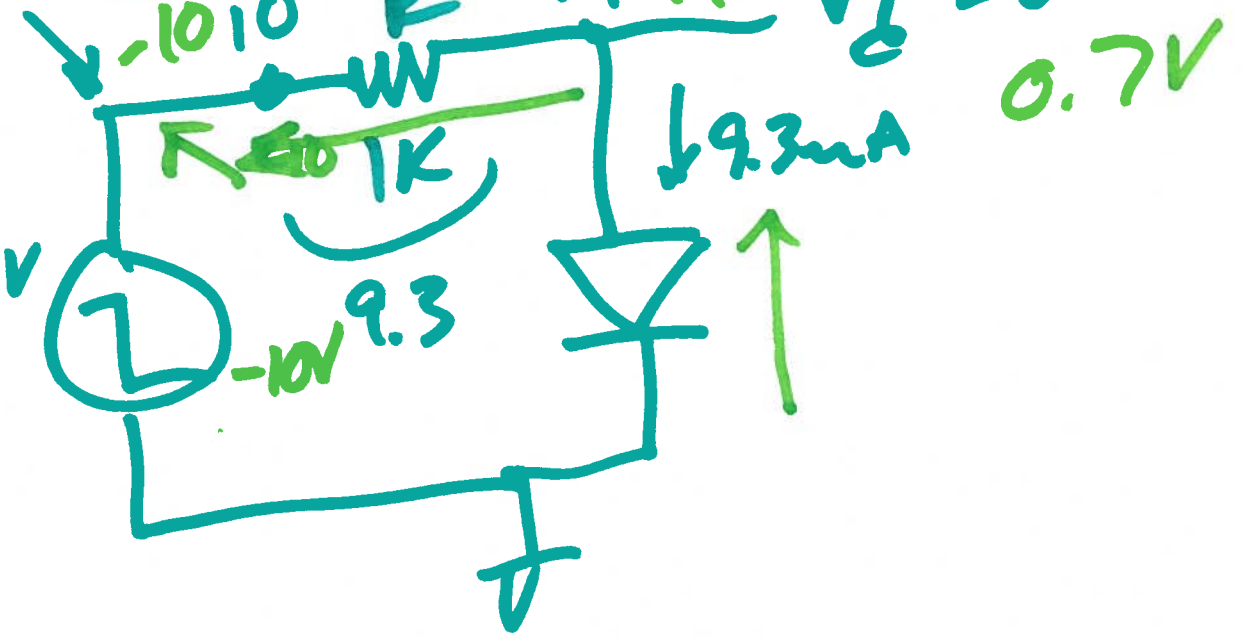
$$t_1 = 0.35l^2rC = 0.7rC\left(\frac{1+2+3+4+\dots+l}{\frac{l^2}{2}}\right) \approx \frac{l(l+1)}{2}$$

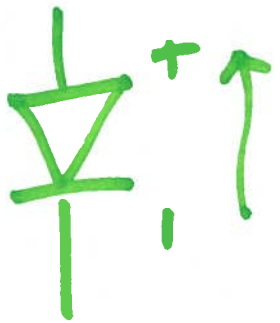
l big

$$t_d = 0.35 \cdot 200^2 \cdot 800 \cdot 900 \times 10^{-18} s$$



$$t_d = 10 ns$$





$V_d = 0.7V$

$0.7V$