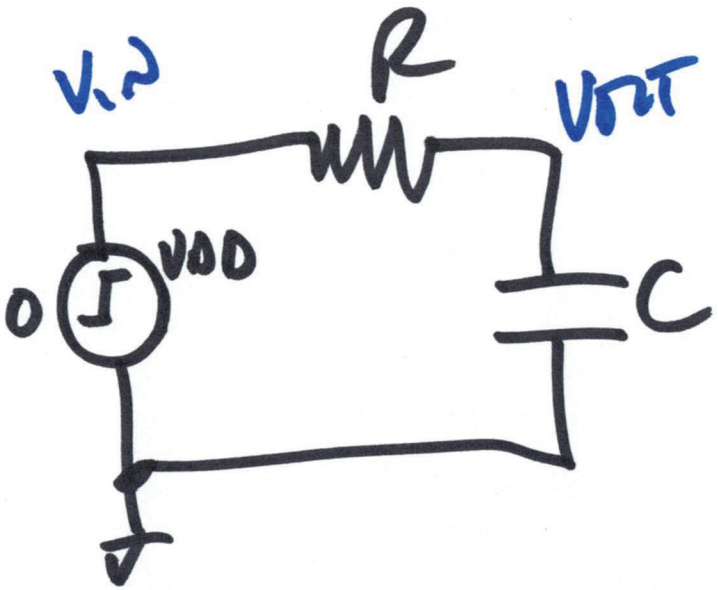
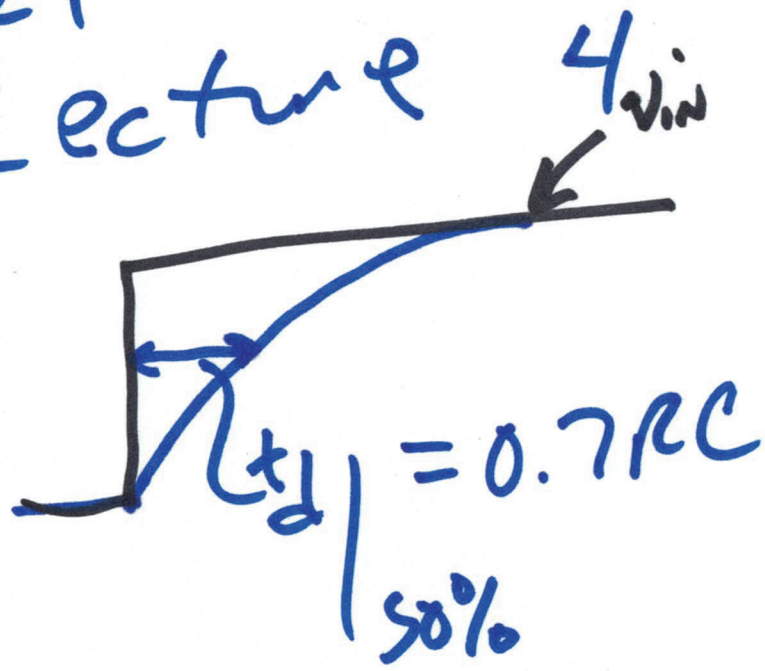
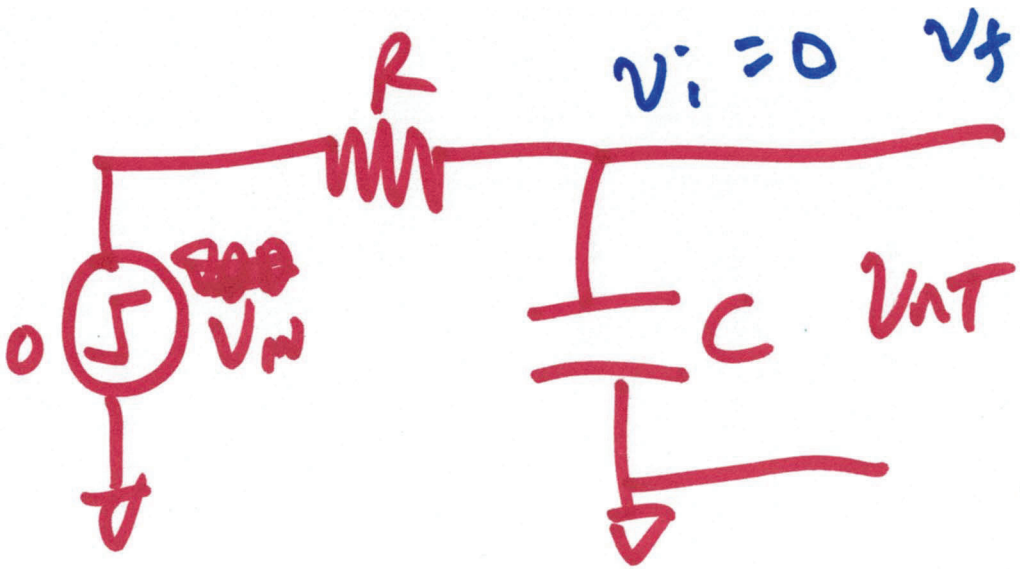
EE 421 / ECE 621
Digital IC Design
9/1/2021
Lecture







$v_i = 0 \quad v_f = V_{IN}$

$$v_{NT} = v_f + (v_i - v_f)e^{-t/RC}$$

$$= V_{IN} - V_{IN}e^{-t/RC}$$

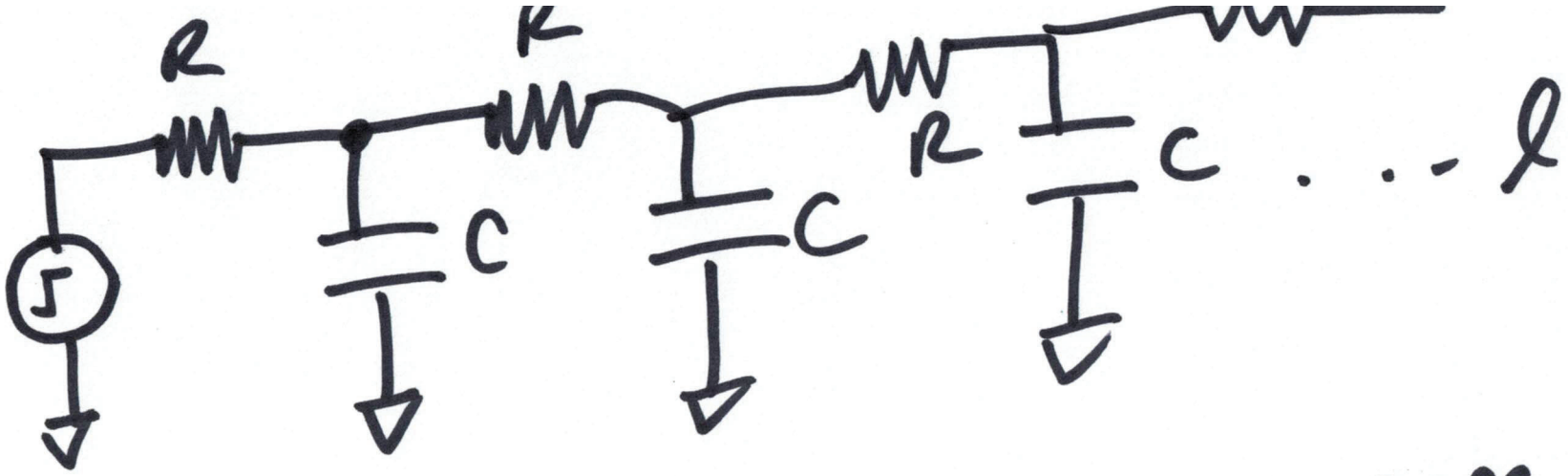
$$= V_{IN}(1 - e^{-t/RC})$$

$$v_{OT} = \frac{V_{IN}}{2} = V_{IN}(1 - e^{-t/RC})$$

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

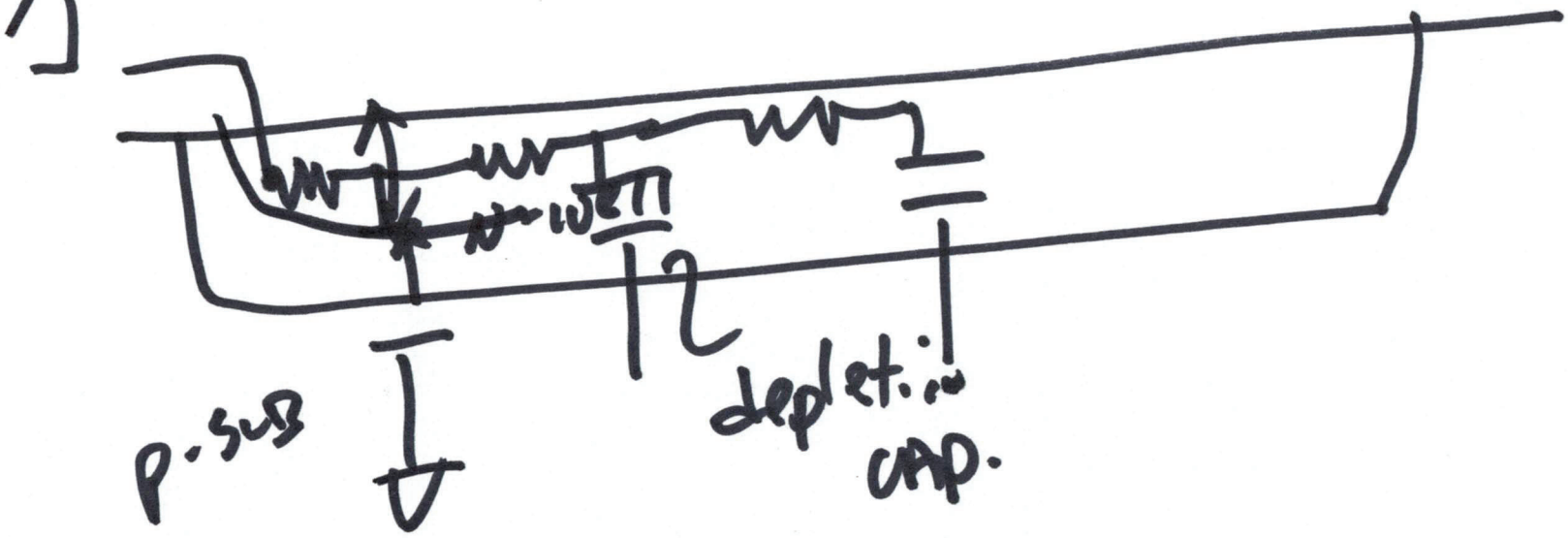
$$-\frac{t}{RC} = -0.7$$

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



$$t_d = 0.7RC + 0.7 \cdot 2R \cdot C + 0.7 \cdot 3RC$$

$$0.7l \cdot R \cdot C$$



$$t_d = 0.7RC\underbrace{(1+2+3+\cdots+\ell)}_{\frac{\ell(\ell+1)}{2}}$$

$$t_d = 0.35 \cdot RC\ell(\ell+1)$$

ℓ is big

$$\boxed{t_d \approx 0.35RC\ell^2}$$

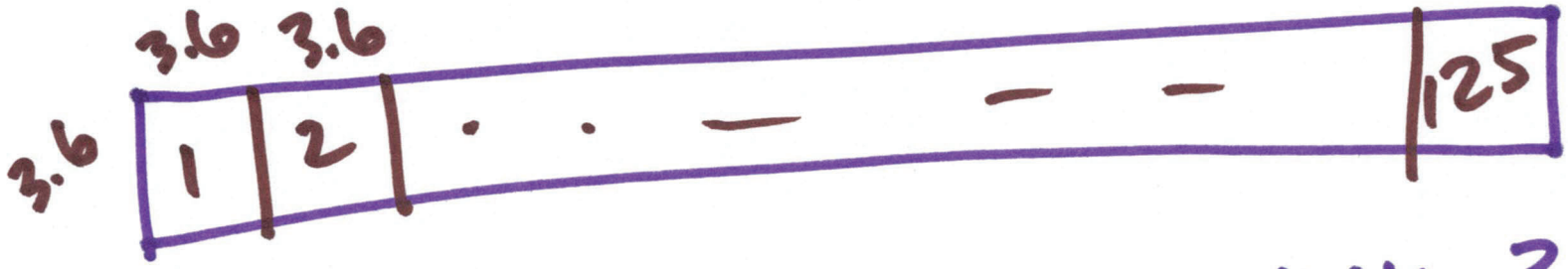
Delay through N-well

100k resistor

$100k = 800 \cdot \frac{L}{W}$

$100k = 800 \cdot \frac{L}{3.6}$

$R_\square = 800\,\frac{\Omega}{\square}$



# of Squares

$\frac{450}{3.6} = 125 = \#$

$r = 800$

$L = \frac{100k \cdot 3.6}{800}$

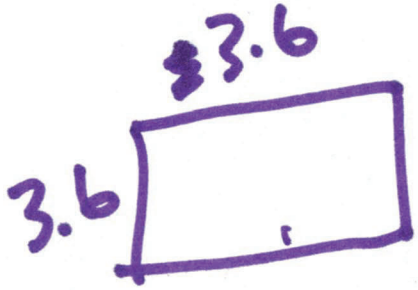
$L = 450$

$W = 3.6$

5)

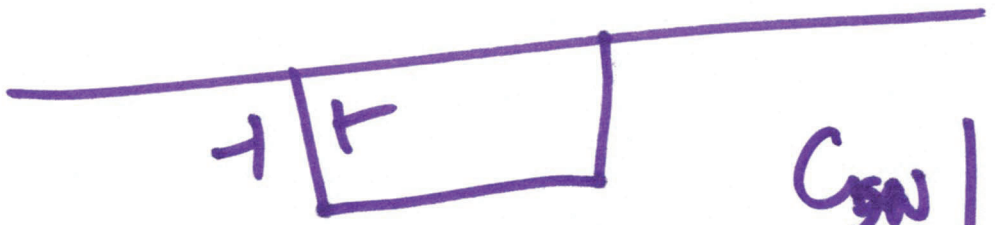
$C_{SW} = 1 fF/\mu m$

$C_{bottom} = 1 fF/\mu m^2$ C_{SW} perimeter



$C_{SW}|_{tot} = \frac{1 fF}{\mu m} \cdot 14.4 \mu m$

$= 14.4 fF$



$C_{SW}|_{tot} = \frac{1 fF}{\mu m^2} \cdot 3.6 \mu \times 3.6 \mu$

$\approx 13 fF$

$C = 14.4 fF + 13$

$C = 27.4 fF$

$l = 125$, $C = 27.4\,fF$, $r = 800$

$$t_d = 0.35 \cdot 27.4\,fF \cdot 800 \cdot 125^2$$

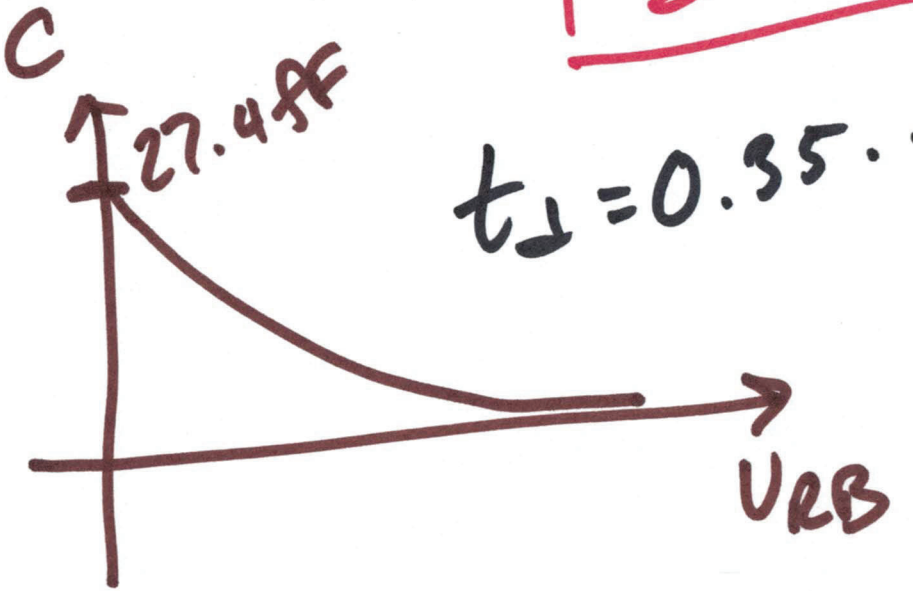
$$t_d \simeq 120\,ns$$

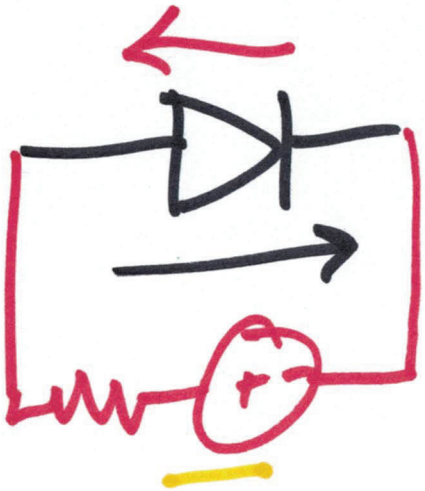
3425 p

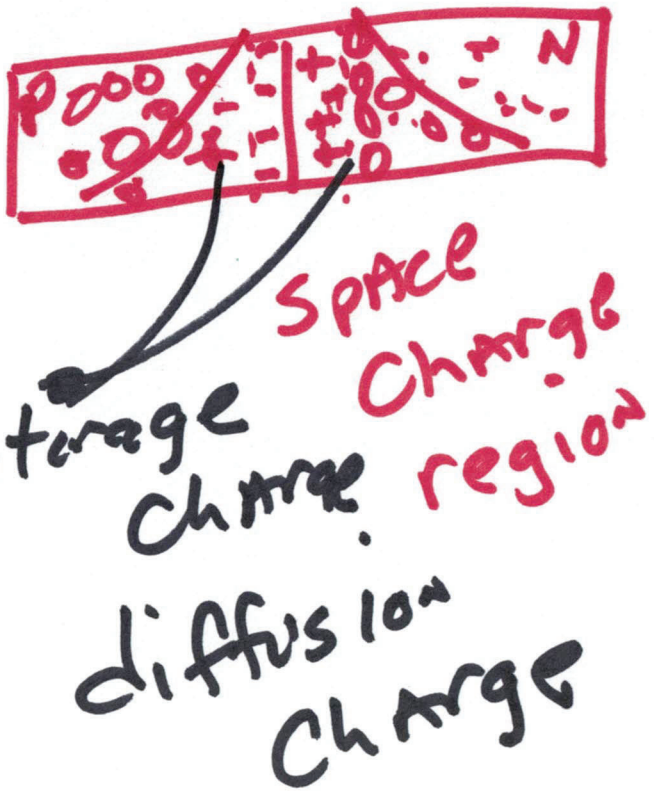
3.425 p

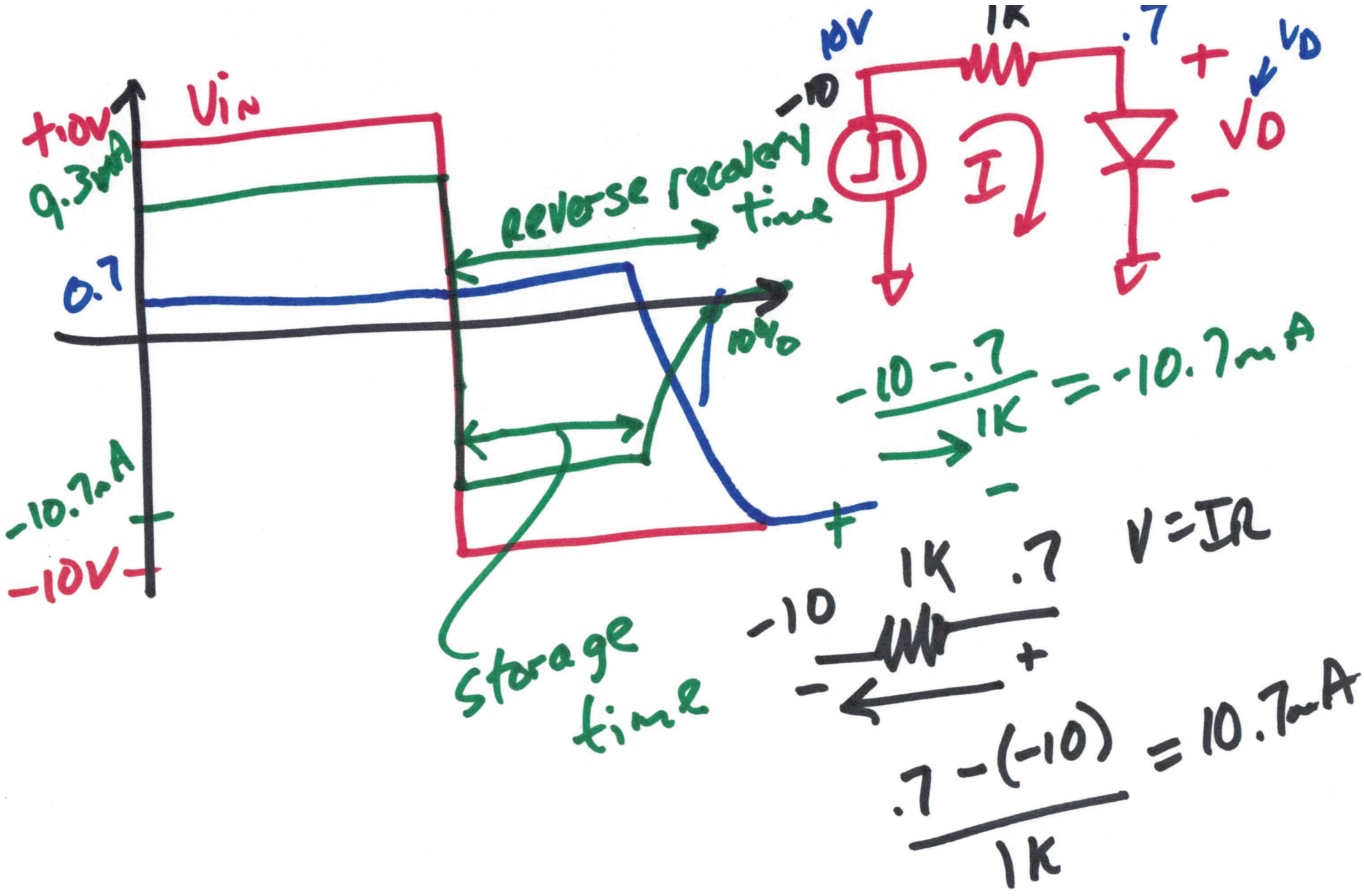
$$t_d = 0.35 \cdot 27.4f \cdot \frac{800 \cdot 125}{R}$$

100K






P
N
Storage Charge
Space Charge region
diffusion Charge


+10V
9.3mA
0.7
-10.7mA
-10V
V_{IN}
reverse recovery time
storage time
10%
10V
1K
.7
V_D
-10
I
$\frac{-10-.7}{1K} = -10.7mA$
$V=IR$
$\frac{.7-(-10)}{1K} = 10.7mA$