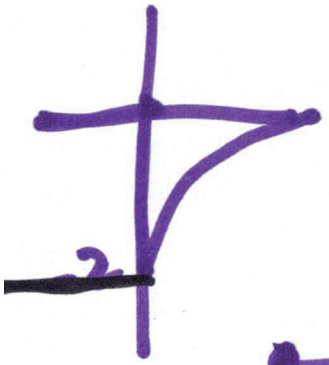
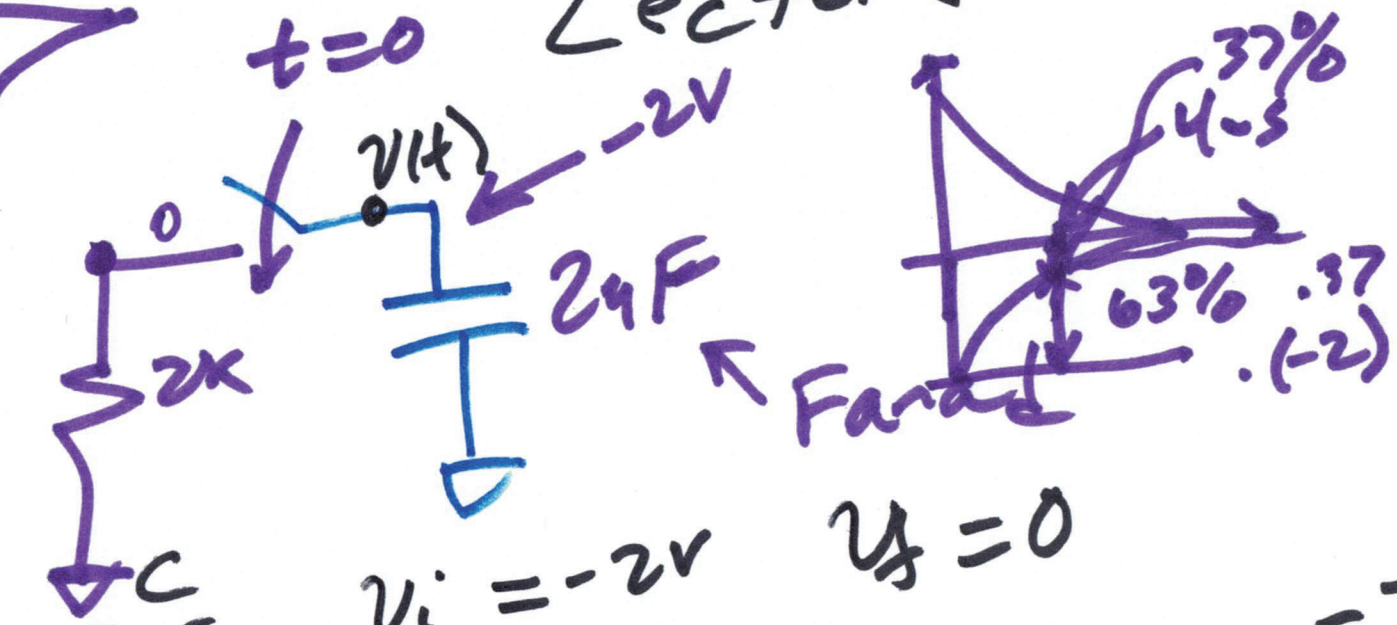
EE 220 Circuits I

October 23, 2023

Lecture 15





atto = 10^{-18}
pico = 10^{-12}
femto = 10^{-15}
nano = 10^{-9}
micro = 10^{-6}
milli = 10^{-3}

R C
2K · 24F
$4 \cdot 10^{3} \cdot 10^{-6}$
$4 \cdot 10^{-3}$

$v_i = -2v \quad v_f = 0$

$$v(t) = v_f + (v_i - v_f)\, e^{-t/RC} \qquad \tau = 4ms$$

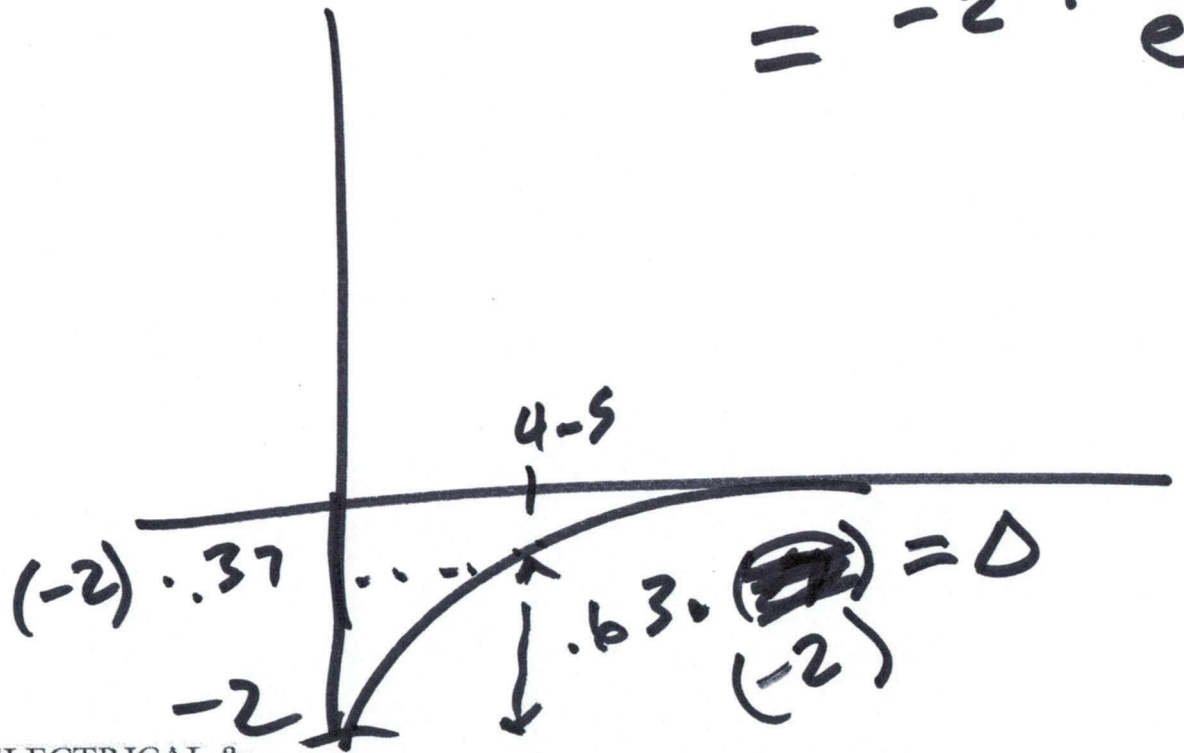
$$= -2e^{-t/4ms}$$

$$v(t) = -2\,e^{-t/4\text{-}s}$$

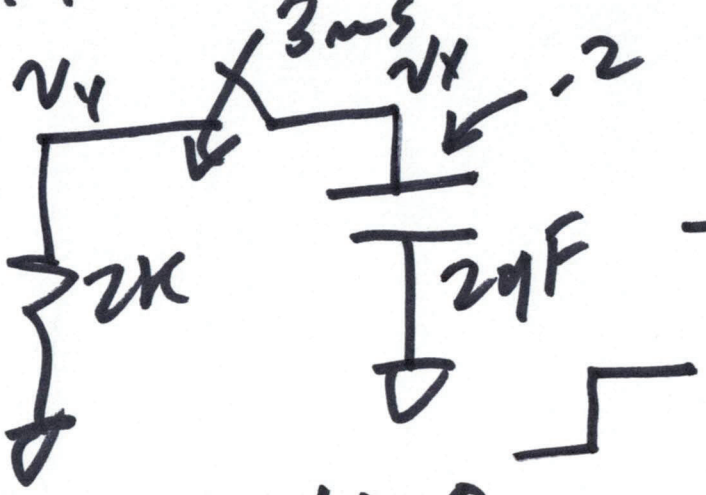
1 τ, $t = 4\text{-}s$

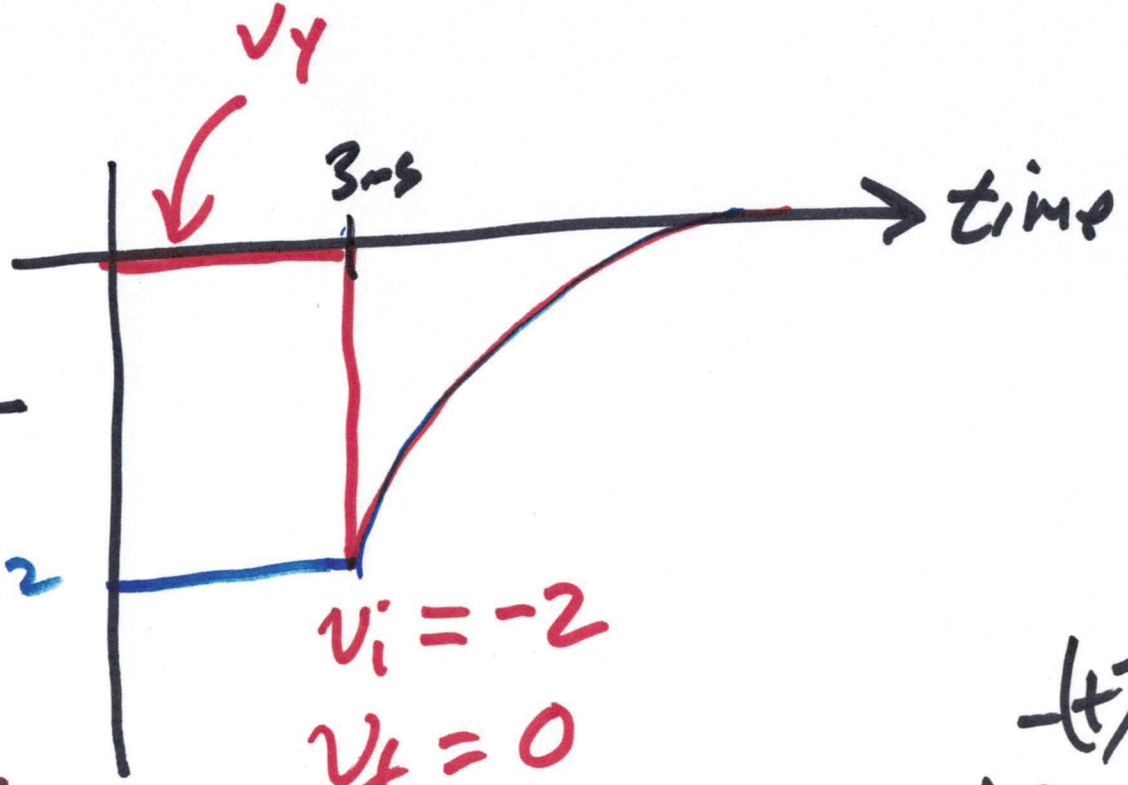
$$= -2\,e^{-4\text{-}s/4\text{-}s} = -2\,e^{-1}$$

$$= -2 \cdot \frac{1}{e} \quad \uparrow 0.37$$



@XYMORON





$u(t) = 1 \quad t > 0$

$0 \quad t < 0$

unit step

$v_i = -2$

$v_f = 0$

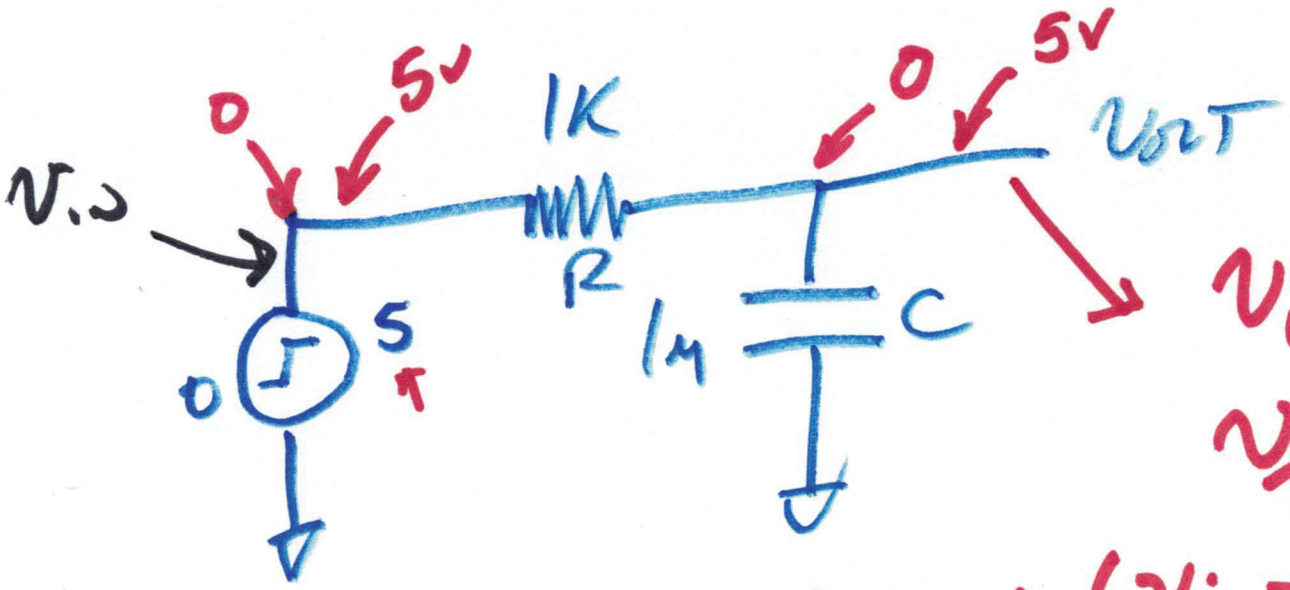
$v_Y = 0, \; t < 3ms$

$v_X = -2 \; t < 3ms$

$v(t) = v_f + (v_i - v_f)e^{-(t-t_i)/R}$

$v_{x,y}(t) = -2e^{-\frac{(t-3ms)}{4ms}} \cdot u(t-3$

$t \geq 3ms$



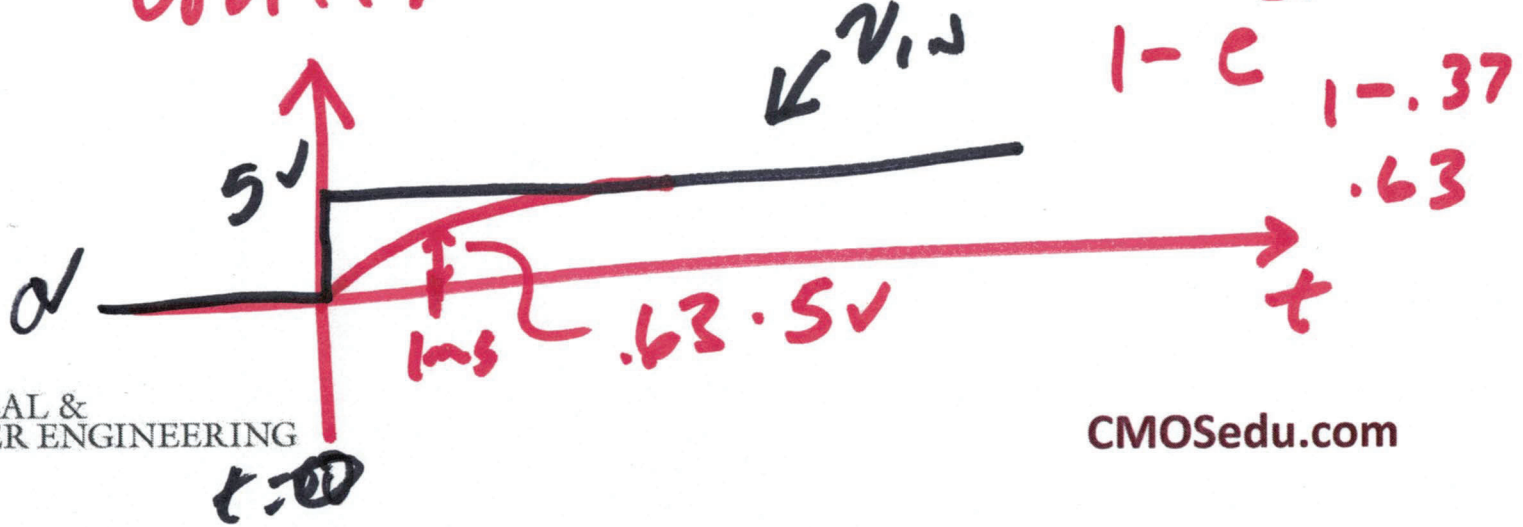
$v_i = 0$

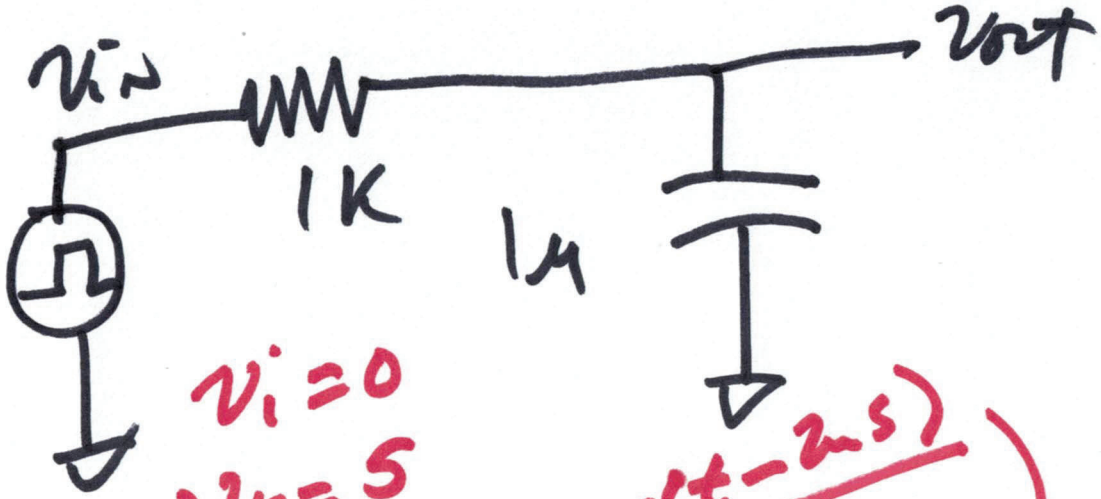
$v_f = 5V$

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

$= 5 + (0 - 5)\, e^{-t/1ms}$ $\quad t \geq 0$

$v_{out}(t) = 5\left(1 - e^{-t/1ms}\right)$



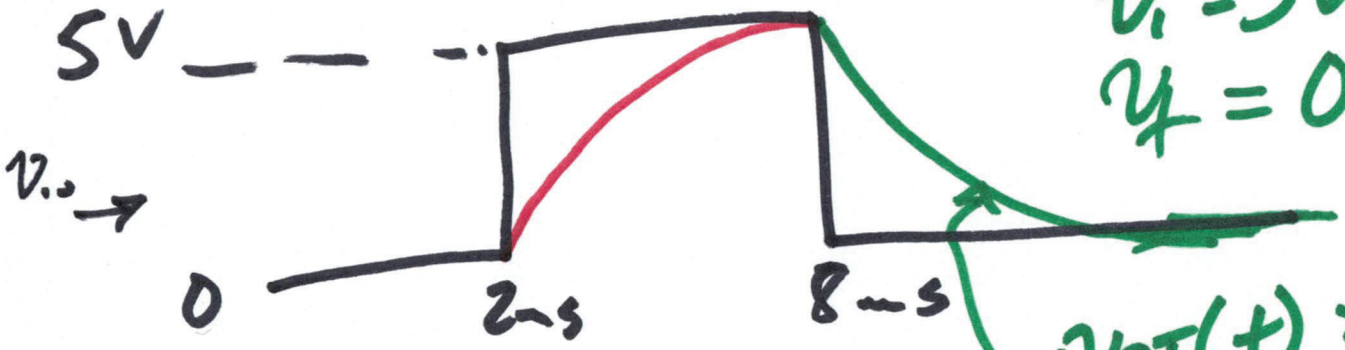


$v_{OUT}(t) = v_f + (v_i - v_f)e^{-\frac{t}{\tau}}$

$v_i = 0$

$v_f = 5$

$v_{OUT}(t) = 5\left(1 - e^{-\frac{(t-2ms)}{1ms}}\right)$ $2ms \le t \le 8ms$



$v_i = 5V$

$v_f = 0$

$v_{OUT}(t) = 5e^{-\frac{(t-8ms)}{1ms}}$

$t \ge 8ms$

$$CV = Q$$

$$I = C\frac{dV}{dt}$$

$$1mA = 1\mu F \cdot \frac{dV}{dt}$$

$$\text{Amps} = \frac{\text{Coulombs}}{\text{sec}}$$

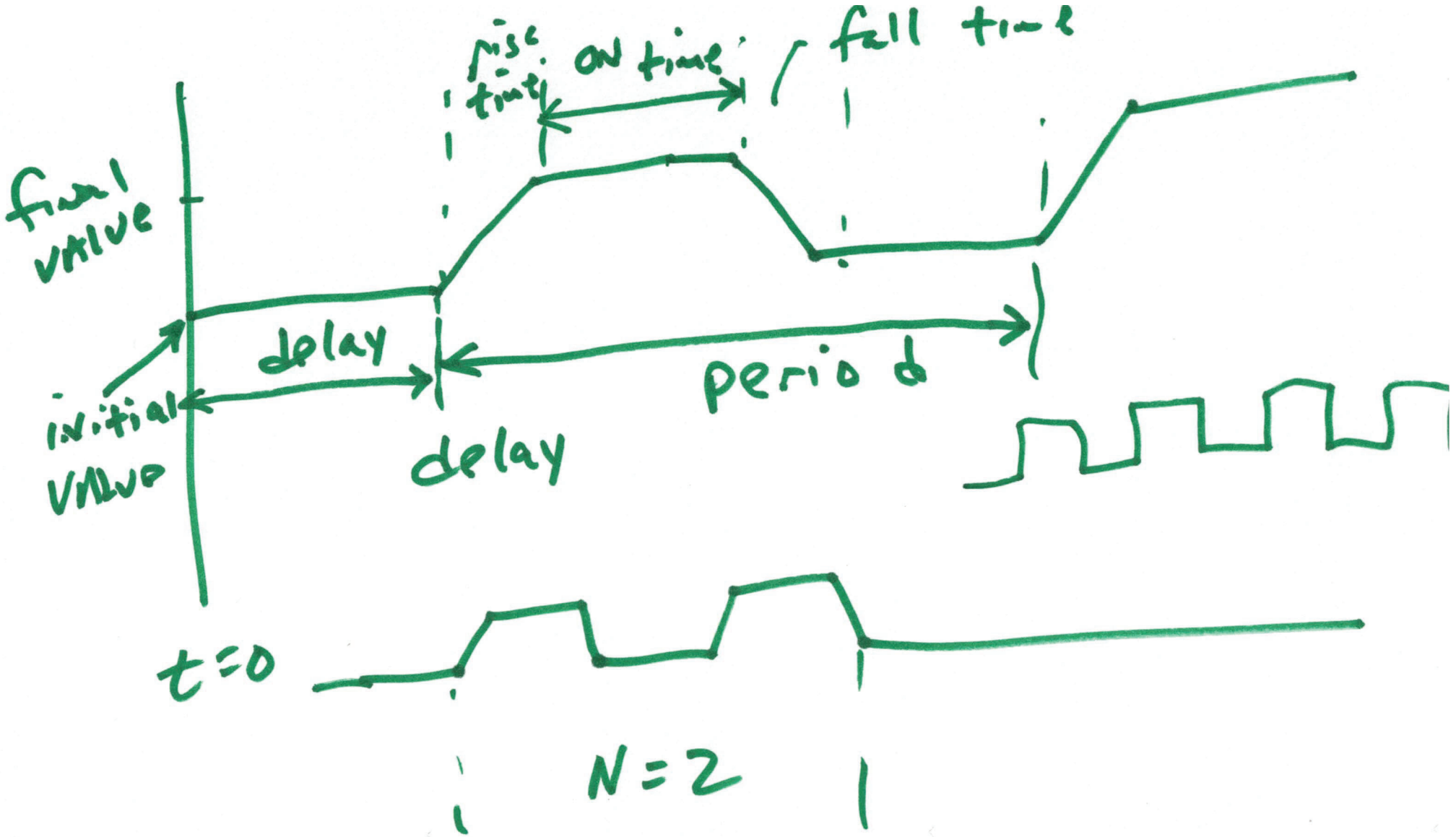
$$\frac{dV}{dt} = \frac{1mA}{1\mu F} = \frac{10^{-3}A}{10^{-6}F}$$

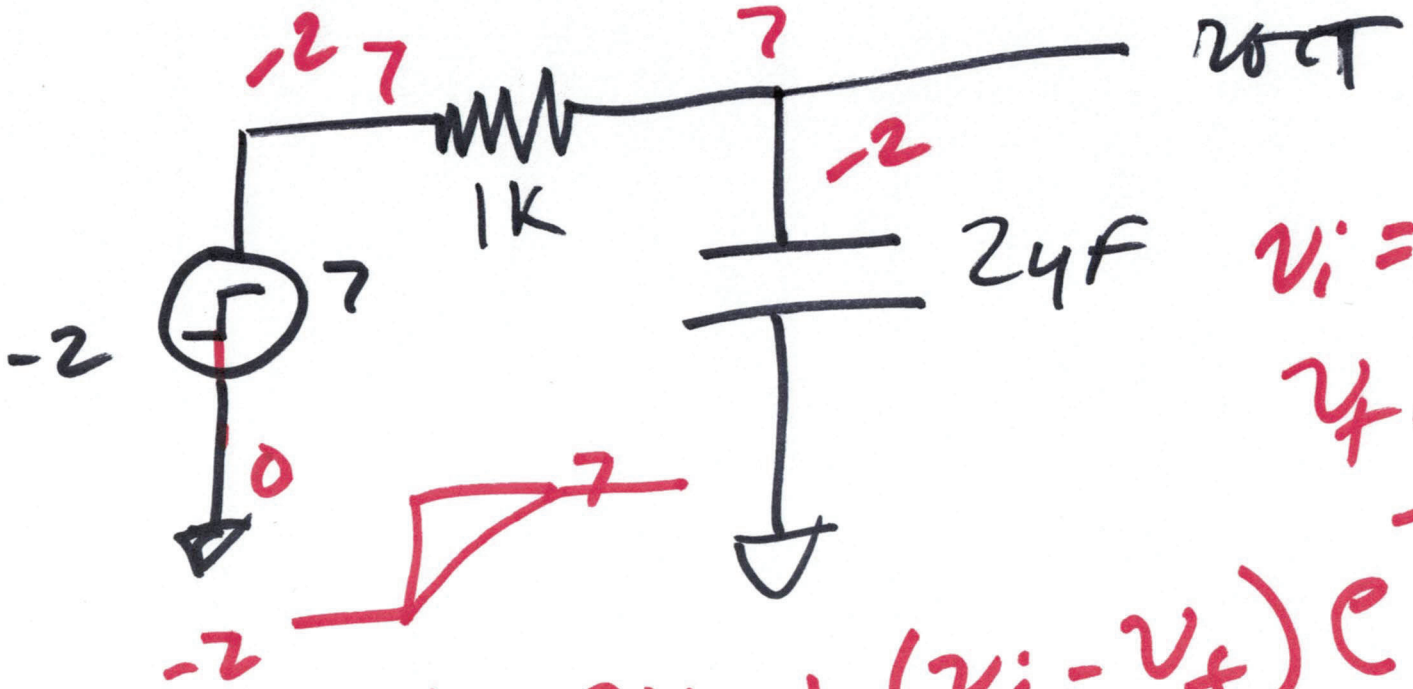
$$\frac{dV}{dt} = \frac{1V}{ms}$$

$$v(t) = \int_0^{v(t)} dv = \int_0^{1ms} \frac{1V}{ms} \cdot dt$$

$$= \frac{1V}{ms} t \Big|_0^t$$

$$\boxed{v(t) = \frac{1V}{ms} \cdot t}$$


rise time
ON time
fall time
final value
initial value
delay
delay
period
t=0
N=2



$v_i = -2$

$v_f = 7$

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

$$= 7 + (-2-7)\,e^{-t/RC}$$

$$= 7 + (-9)\,e^{-t/RC}$$

$t = 0 \rightarrow v_{OUT}(0) = -2$

$t = \infty \rightarrow v_{OUT}(\infty) = 7$