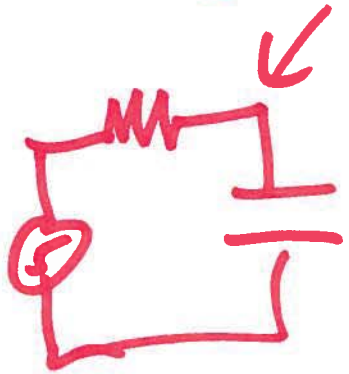
EE 220
circuits 1

Lecture 17



$V(1-e^{-t/RC})$

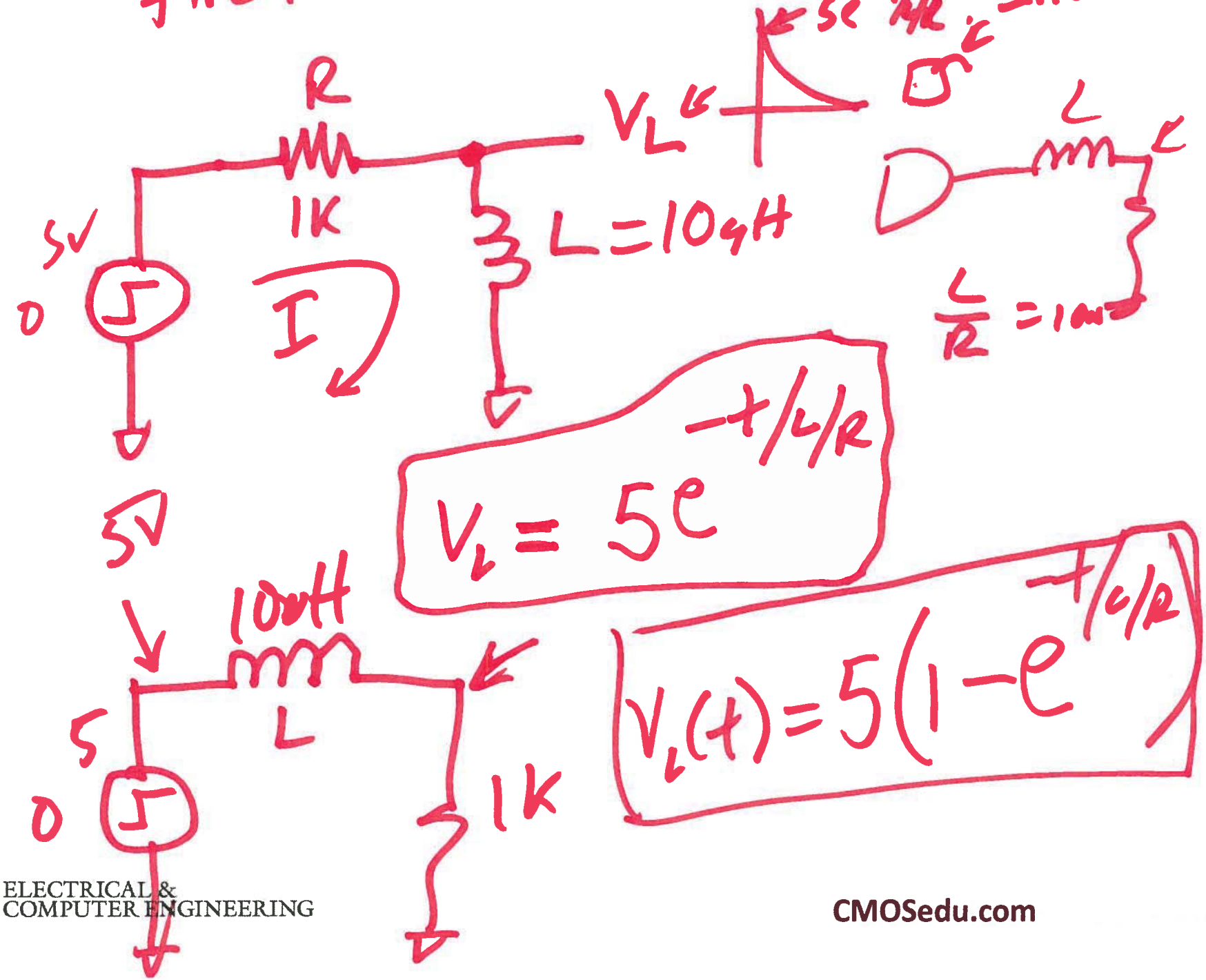
$1N \leq t \leq 61ns$

$V_C^{(1)} = 5(1-e^{-(t-1ns)/RC})$

$61ns \leq t$

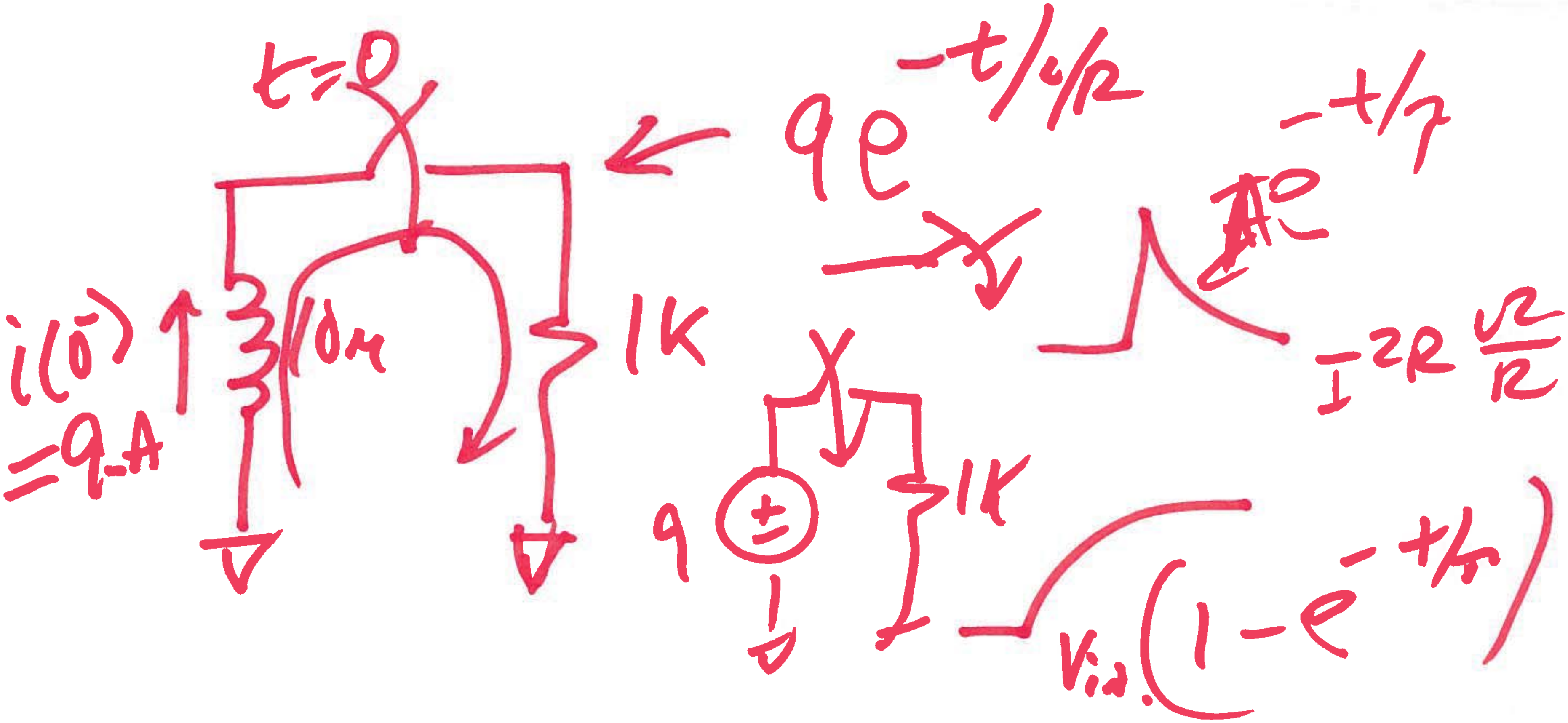
$V_c(t) = 5 - 5(1-e^{-\frac{(t-61ns)}{10ns}})$

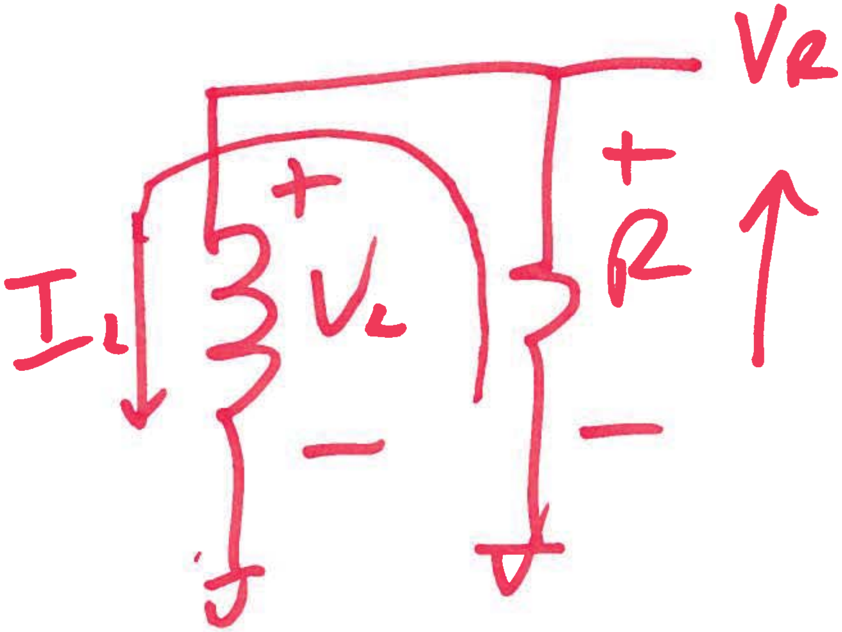
first-order LR circuits



$$V_L = 5e^{-t/L/R}$$

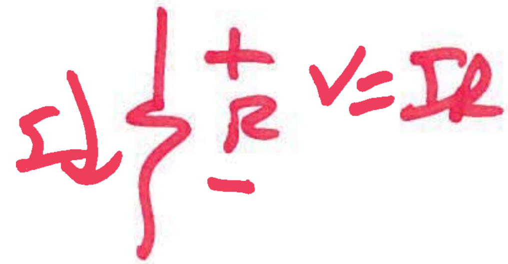
$$V_L(t) = 5\left(1 - e^{-t/L/R}\right)$$


t=0
i(0⁻) = 9 A
10 μ
1K
9e^{-t/L/R}
Ae^{-t/τ}
I²R V²/R
9
1K
V_in(1 - e^{-t/τ})

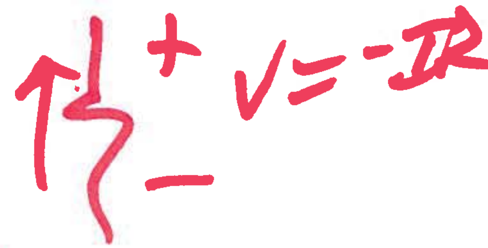


$$V_L = L \frac{dI_L}{dt}$$

$$I_L = \frac{1}{L} \int V_L \cdot dt$$



$$V_L = V_R = -I_L \cdot R$$



$$L \cdot \frac{dI_L}{dt} = -I_L \cdot R$$

$$\int^{i(t)} \frac{dI_L}{I_L} = \int_0^t -\frac{R}{L} \cdot dt$$

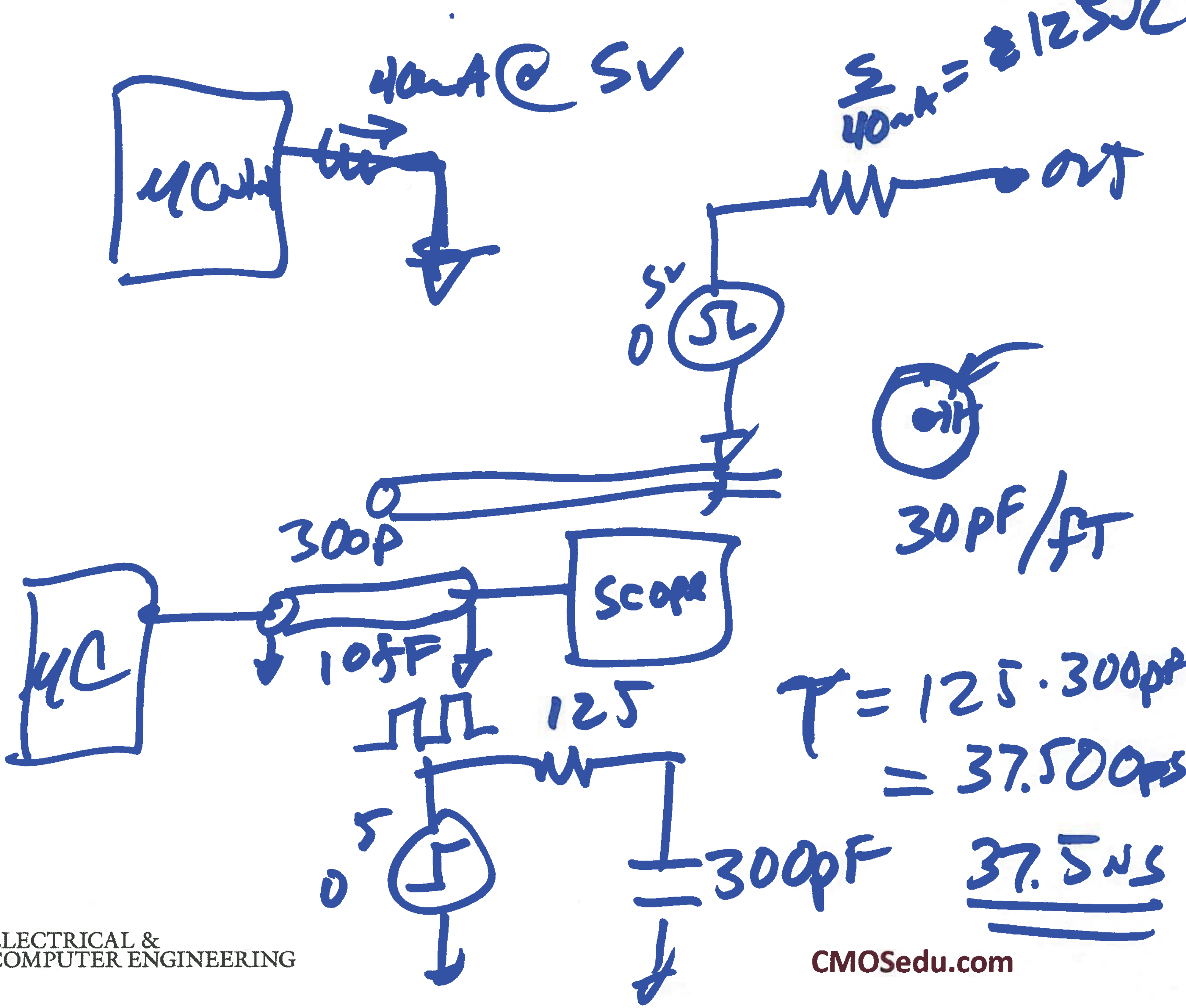
$$\int_{I_{Init}}^{i_L(t)} \frac{dI_L}{I_L} = \int_0^t -\frac{R}{L} \cdot dt$$

$$= \ln \frac{i_L(t)}{I_{Init}} = -\frac{(t-0)}{L/R}$$

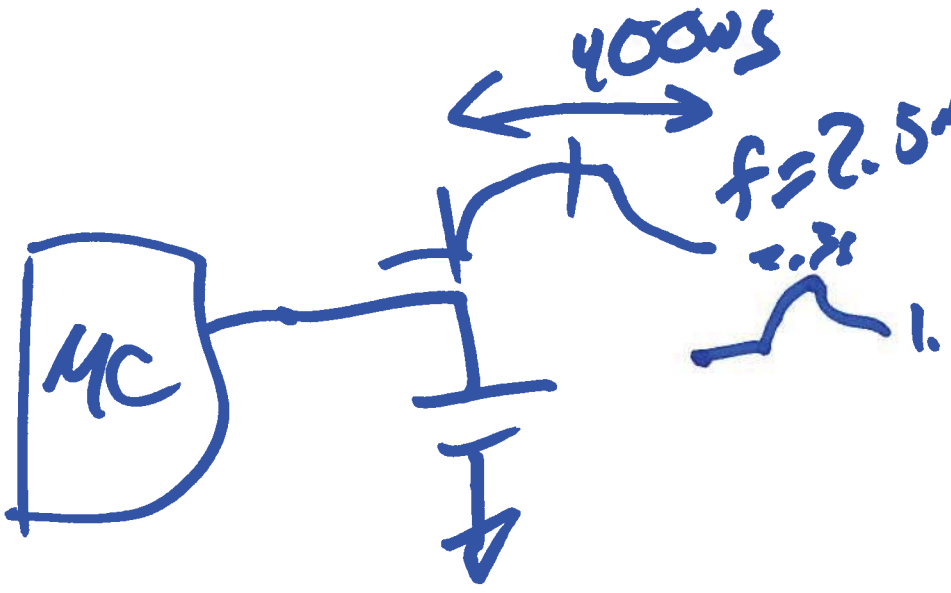
$$\ln i_L(t) - \ln I_{Init}$$

$$i_L(t) = I_{Init} \cdot e^{-t/L/R}$$

$$V_R(t) = R \cdot I_{Init} \cdot e^{-t/L/R}$$



40mA @ 5V
5/40mA = 125Ω
5V
0
30pF/ft
300p
Scope
10ft
125
T = 125 · 300pF
= 37,500ps
37.5ns
5
0
300pF

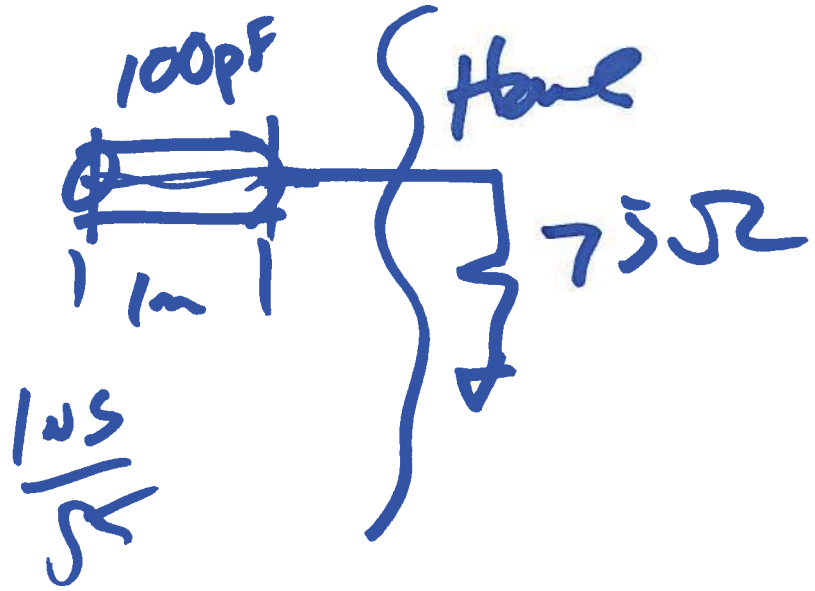


$T = 37.5\,NS$

$57 = 187.5\,NS$

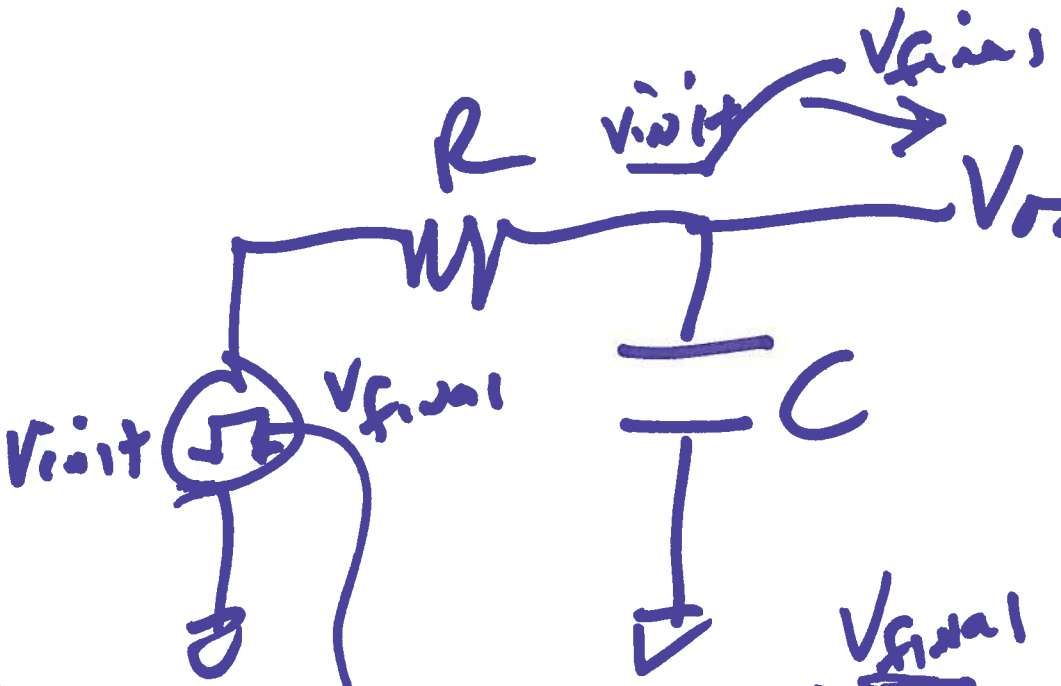
$f = 10\,MHZ$

$T = 100\,NS$



$\frac{1NS}{5K}$

$\frac{1}{T}\ \frac{30pF}{fT} \cdot \text{length}$

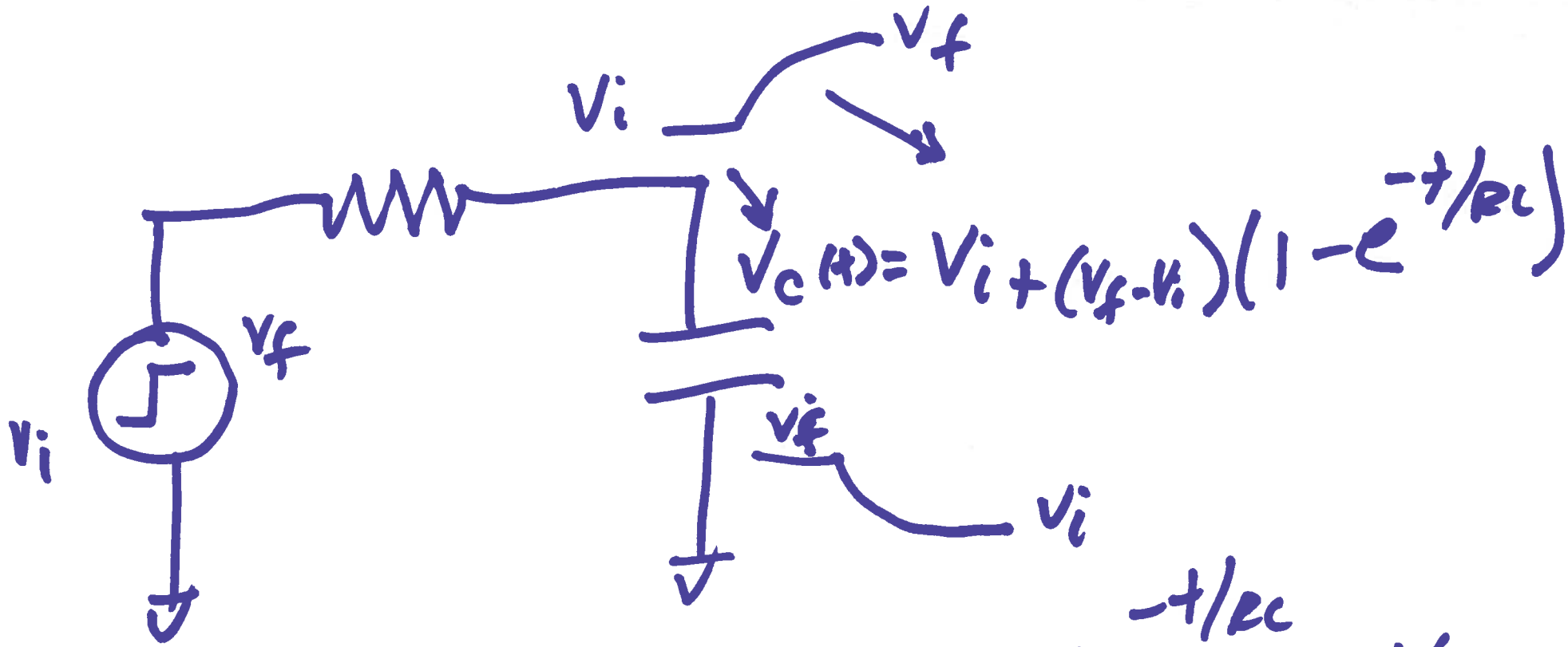


$V_{OUT} = V_{init} + V_{final}\left(1 - e^{-t/RC}\right)$

Right to zero

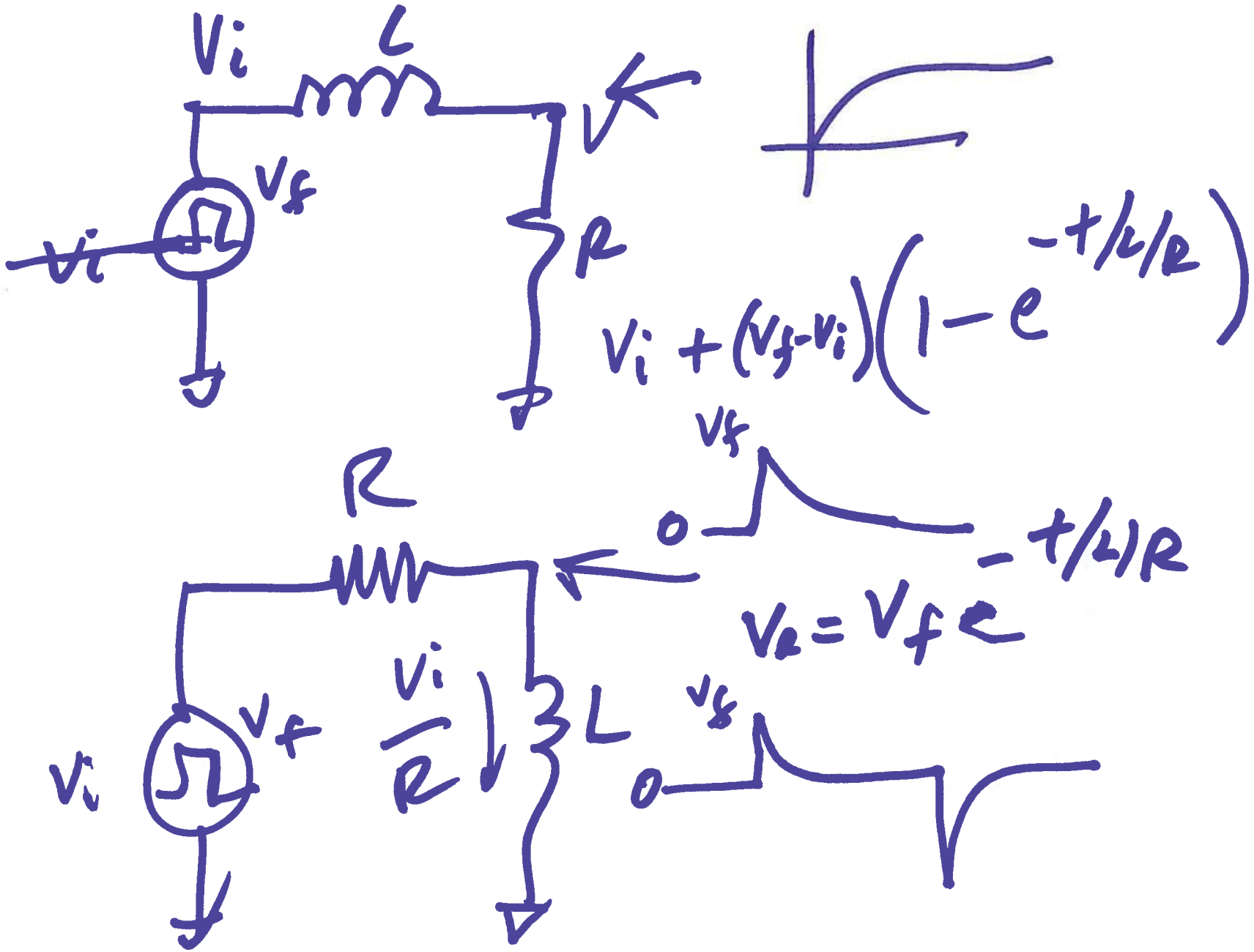
$V_{OUT} = V_{final} + \left(V_{init} - V_{final}\right)\left(1 - e^{-t/RC}\right)$

$V_{OUT}(t) = \left(V_{final} - V_{init}\right)e^{-t/2C} + V_{init}$



$$v_c(t) = (V_f - V_i)e^{-t/RC} + V_i$$

$$= V_f + V_i\left(1 - e^{-t/RC}\right)$$


Vi
L
Vf
Vi
R
Vi + (Vf - Vi)(1 - e^{-t/L/R})
R
Vf
0
-t/L/R
Vi
Vf
Vi/R
L
Vf
0