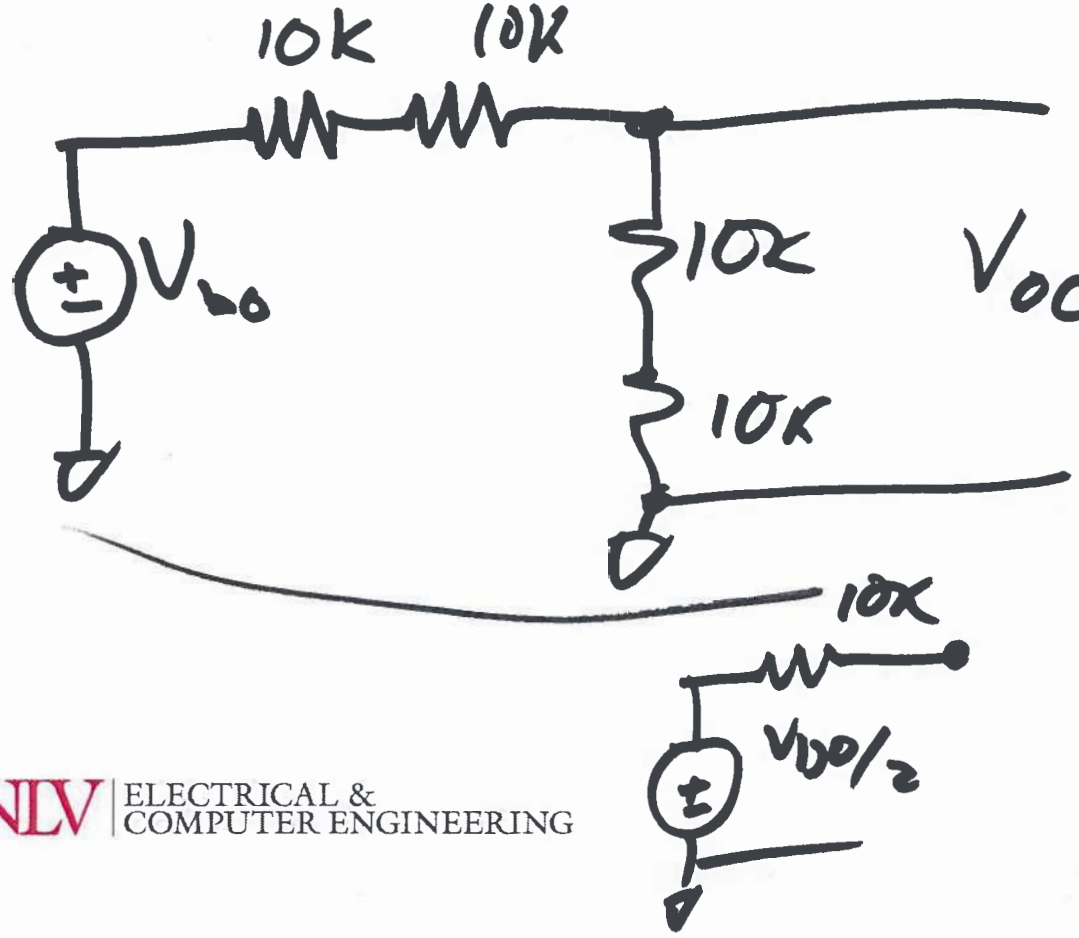
EE 220 Circuits 1

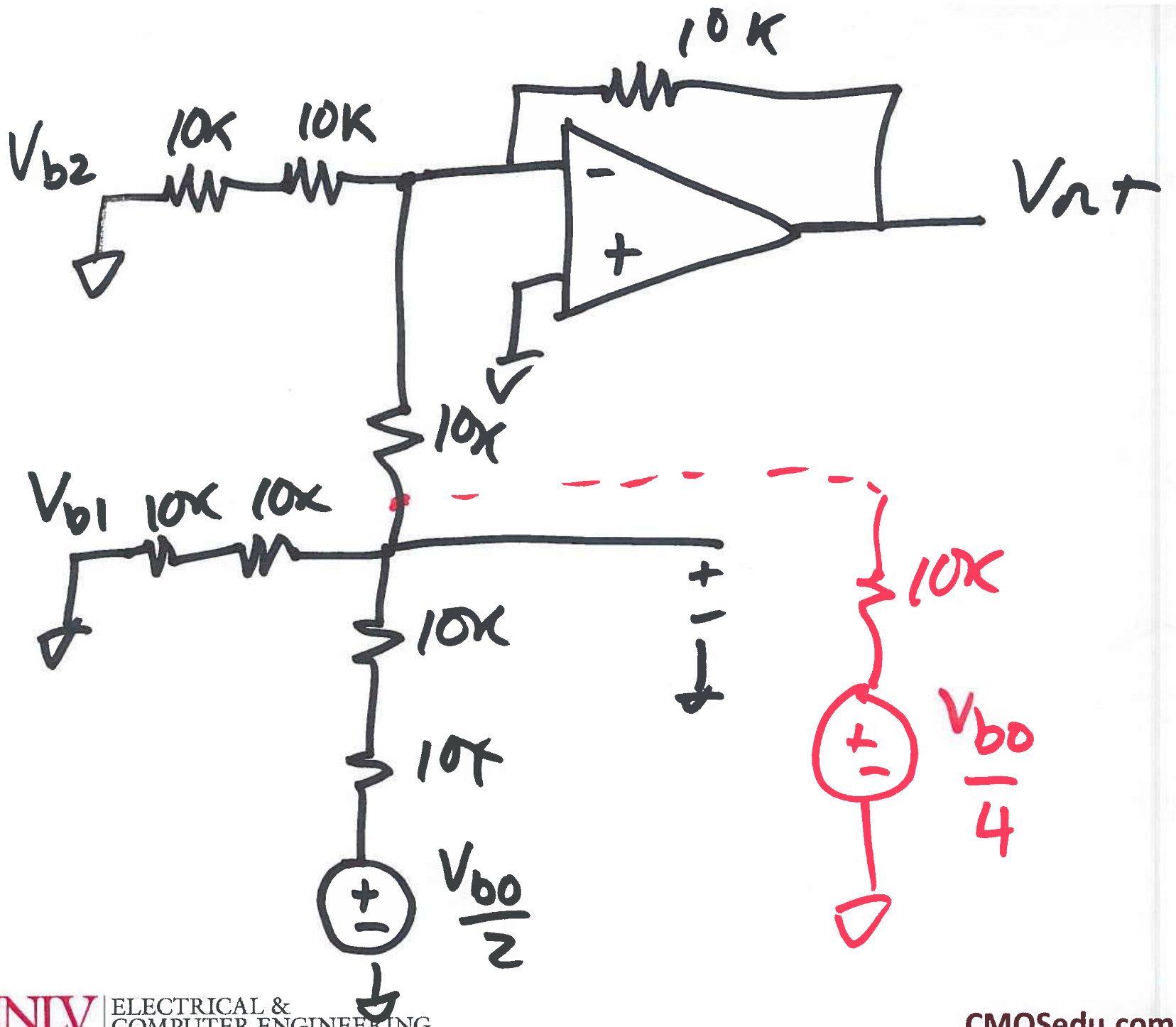
Lecture 16

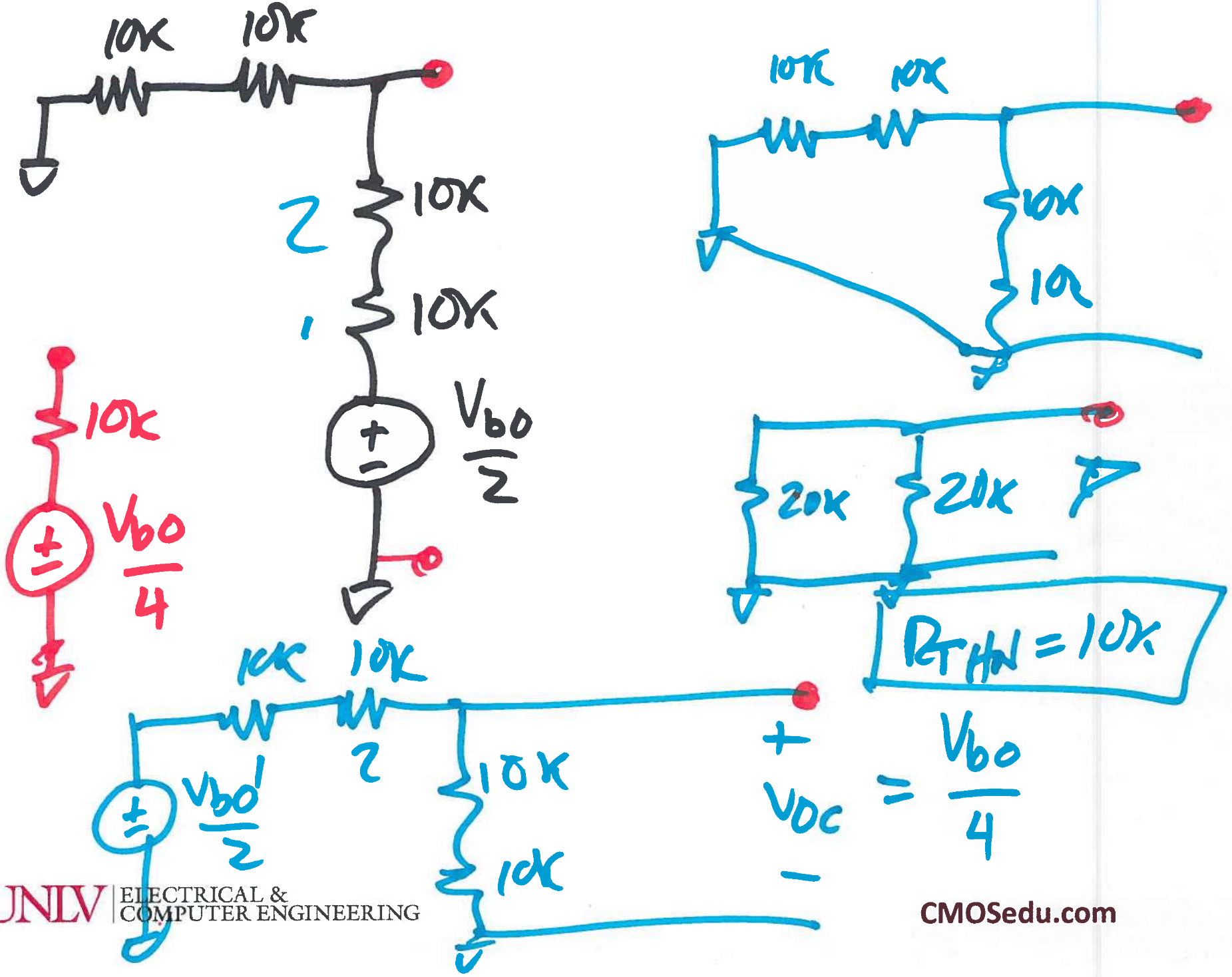
OCT. 22, 2018



$$V_{OC} = \frac{V_{DD}}{2}$$

$$R_{TH} = 10K$$


10K
V_{b2}
10K
10K
V_{out}
10K
V_{b1}
10K
10K
10K
10K
$\frac{V_{bb}}{2}$
10K
$\frac{V_{bb}}{4}$



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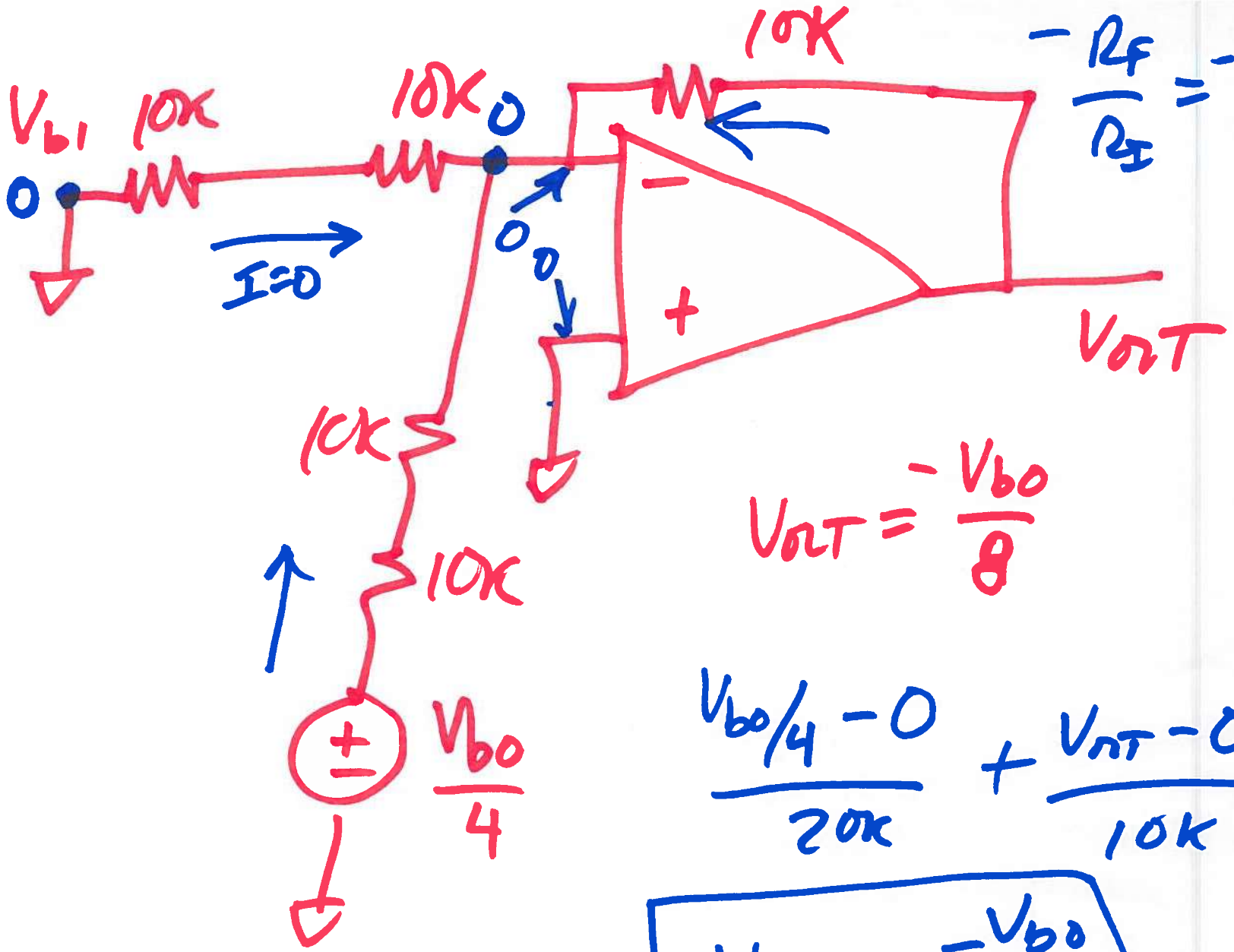
3)

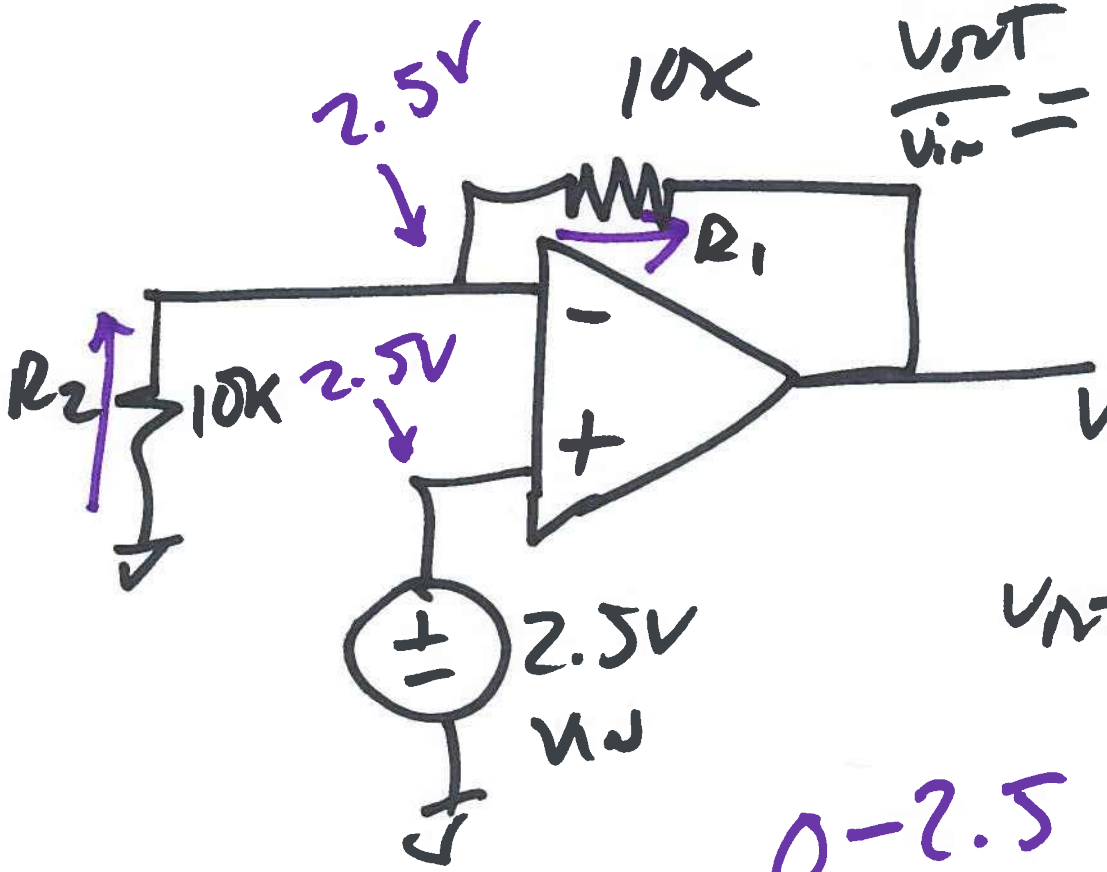


$$-\frac{R_F}{R_I} = \frac{-20K}{20K} = -1$$

$$V_{oT} = \frac{-V_{bo}}{8}$$

$$\frac{V_{bo}/4 - 0}{20K} + \frac{V_{oT} - 0}{10K} = 0$$

$$\boxed{V_{oT} = \frac{-V_{bo}}{8}}$$



$$\frac{V_{OUT}}{V_{in}} = 1 + \frac{R_1}{R_2} = \frac{R_2 + R_1}{R_2}$$

$V_{OUT} = 5V$

$$\frac{0 - 2.5}{10K} = \frac{2.5 - V_{OUT}}{10K}$$

$\boxed{V_{OUT} = 5V}$

5)

$$I = C\frac{dv}{dt}, \quad v = \frac{1}{C}\int i \cdot dt$$

$$\frac{0.54A}{1.5\mu s} = \frac{1}{3}$$

$$i(t) = \frac{1}{3}\left(t - \frac{1}{2}\mu s\right)$$

$$\frac{1}{2}\mu s < t \leq 2\mu s$$

$$i(t) = \frac{1}{3}t$$

$$v(t) = \frac{1}{C}\int_{1/2\mu s}^{2\mu s}\left(t - \frac{1}{2}\mu s\right)dt$$

$$U(t) = \int_0^{1.1/2\mu s} \frac{1}{3}t \cdot dt = \frac{1}{C}\frac{1}{6}t^2\Big|_0^{1/2\mu s}$$

$$\frac{1}{10^{-12}} \cdot \frac{1}{6} \cdot \left(1.5\times10^{-6}\right)^2 \qquad \frac{2.25\cdot10^{-12}}{60\cdot10^{-12}}$$

b)

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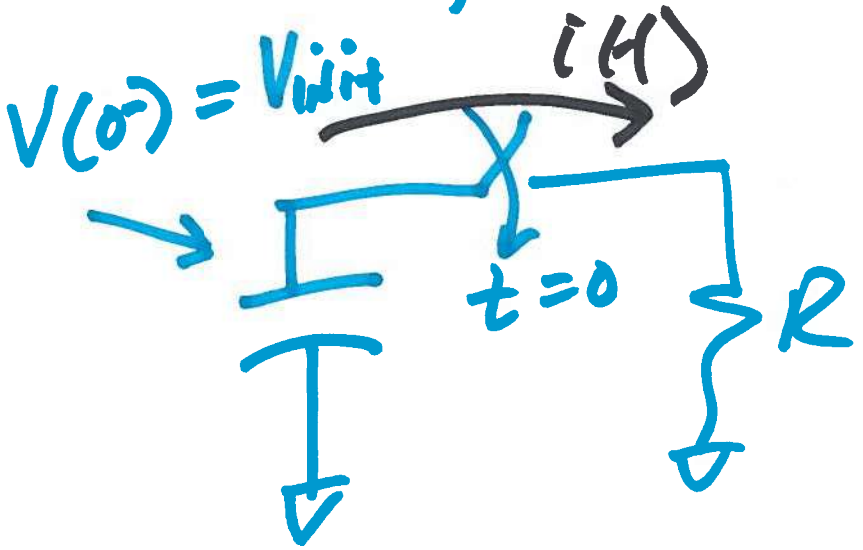
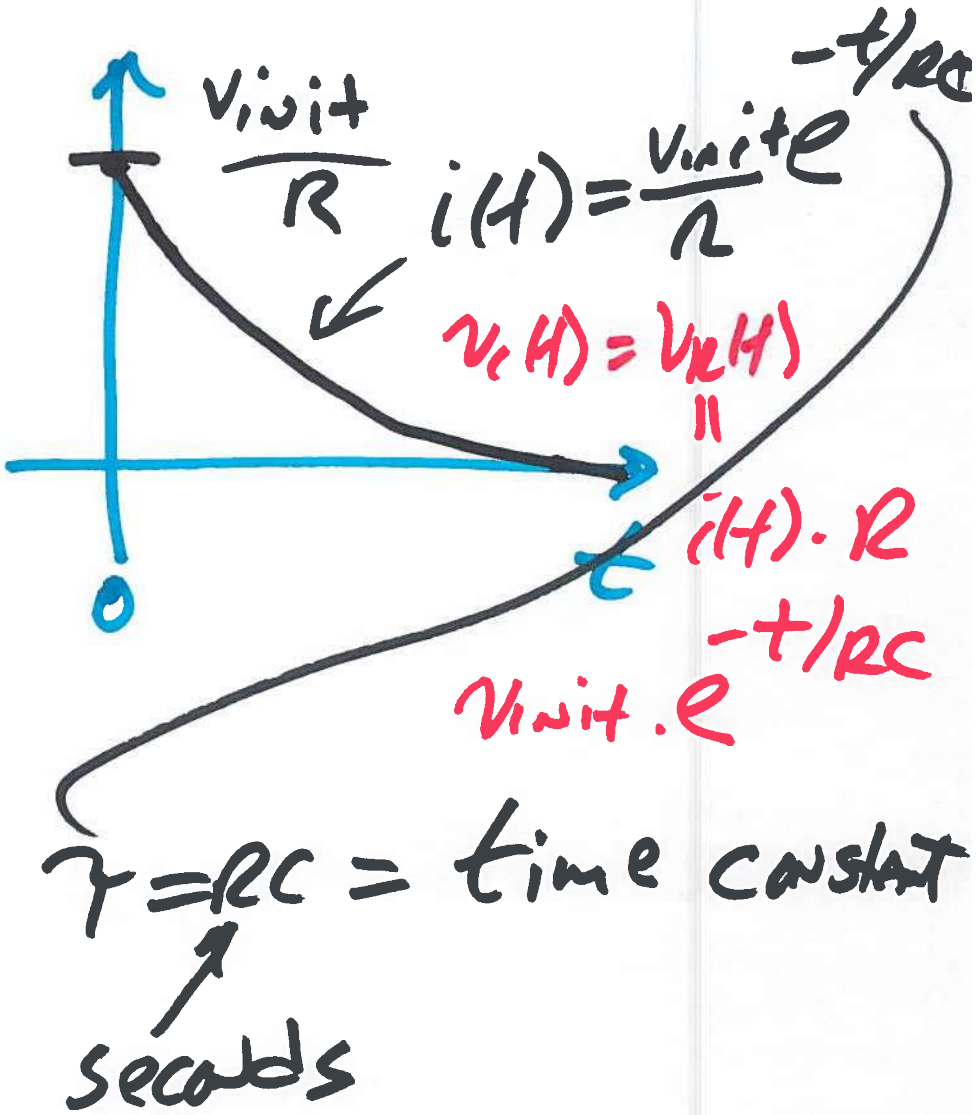
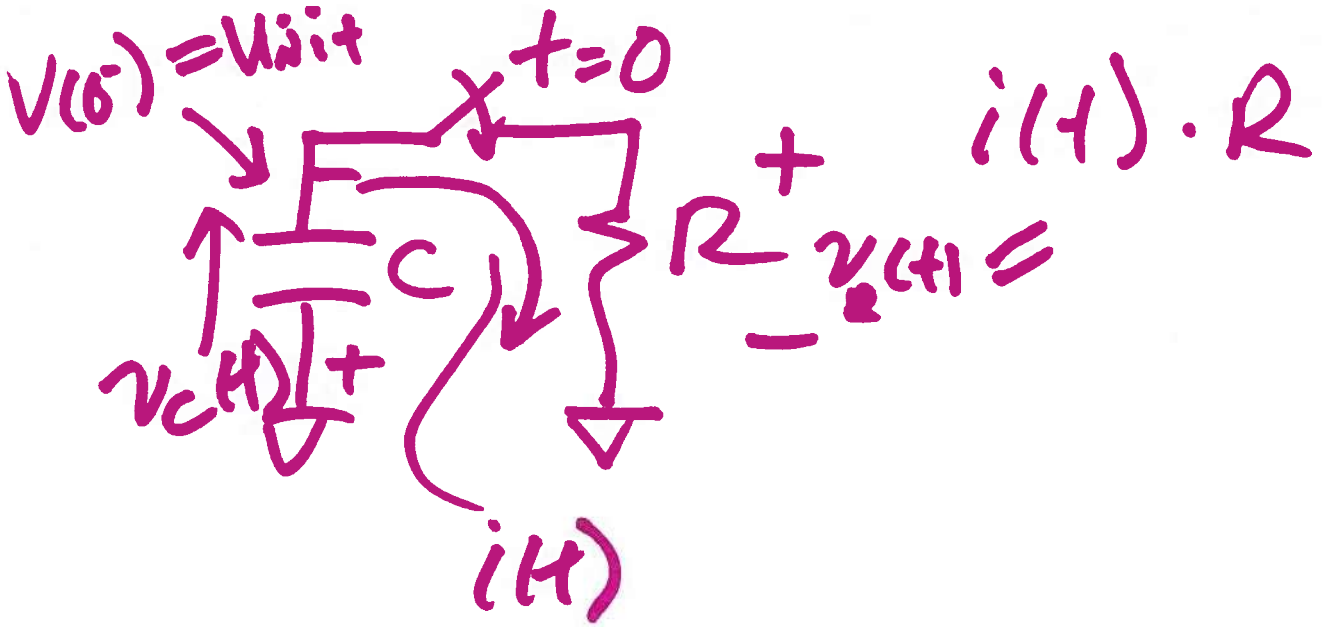
first-order (NO source)





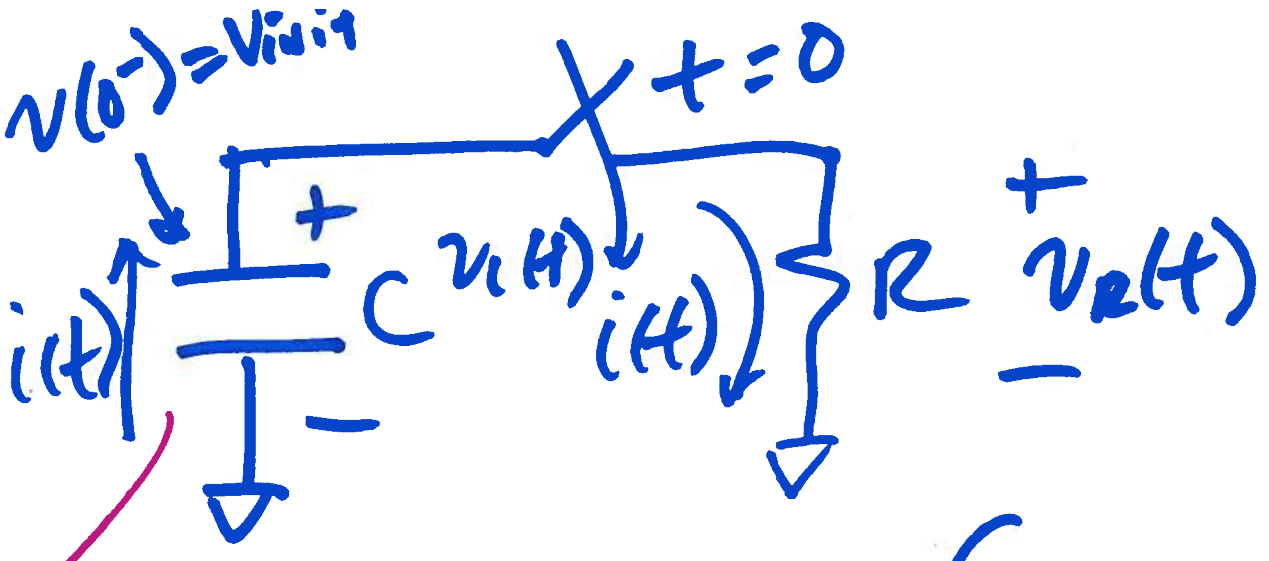
$\tau = RC$ = time constant

seconds

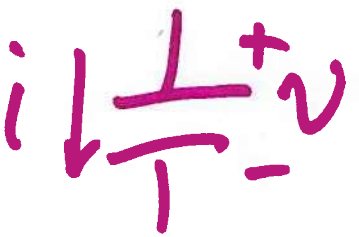


$$v \;\overset{+}{\underset{-}{\big|}}\; \frac{1}{T} \downarrow i \qquad i = C\frac{dV}{dt}$$

$$-V_C = \frac{1}{C}\int -i \cdot dt = i(t)\cdot R = V_R$$



$$i = C\frac{dv}{dt}$$



$$-i = C\frac{dv}{dt}v_c(t) = \frac{1}{C}\int -i(t)\cdot dt = v_R(t) = i(t)R$$

$$v_c(t) = i(t)\cdot R = -RC\frac{dv_c(t)}{dt}$$

$$v_c(t) + RC\frac{dv_c(t)}{dt} = 0$$

$$v_c + RC\frac{dv_c}{dt} = 0$$ Separation

$$v_c = -RC\frac{dv_c}{dt}$$

$$-\frac{t}{RC} = \int_0^t \frac{1}{RC}\,dt = \int_{V_{init}}^{v_c(t)} \frac{dv_c}{v_c} = \ln v_c \Big|_{V_{init}}^{v_c(t)}$$

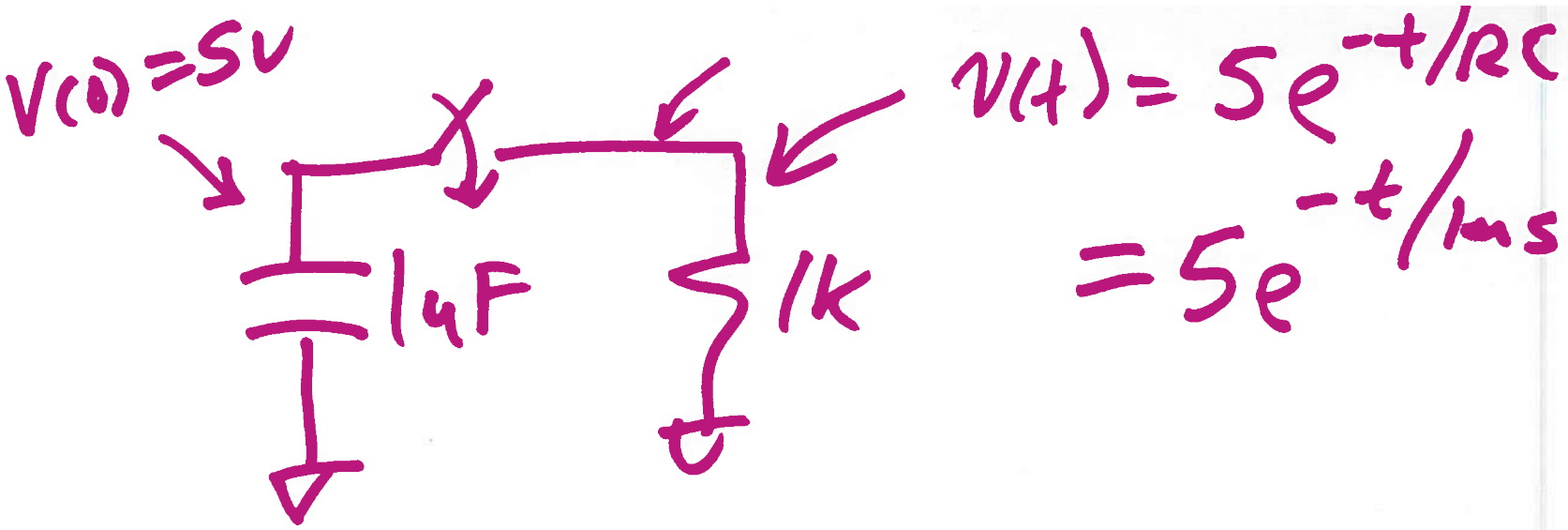
$$-\frac{t}{RC} = \ln v_c(t) - \ln V_{init}$$

$$-\frac{t}{RC} = \ln \frac{v_c(t)}{V_{init}}$$

$$v_c(t) = V_{init}\, e^{-t/RC}$$

$$\ln A - \ln B = \ln \frac{A}{B}$$

$$\ln \frac{v_c}{V_{init}}$$


V(0)=5V
1μF
1k
v(t) = 5e^{-t/RC}
= 5e^{-t/1ms}