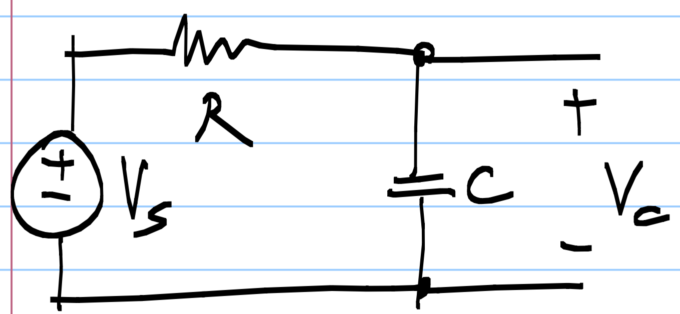
$R > 0,\ L,\ C$

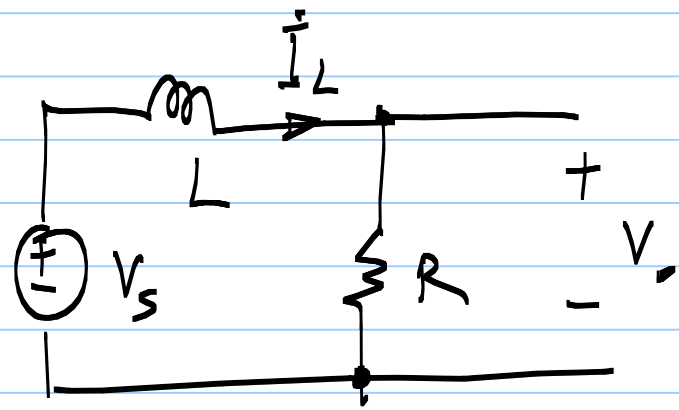
EE 2015 — First order systems with constant inputs — 19/9/2017



$$\frac{dV_c}{dt} + \frac{1}{RC} \cdot V_c = \frac{V_s}{RC}$$

exp$(-t/\tau)$

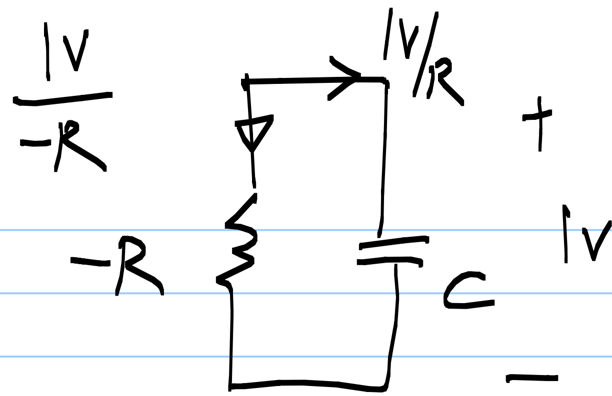
time constant τ



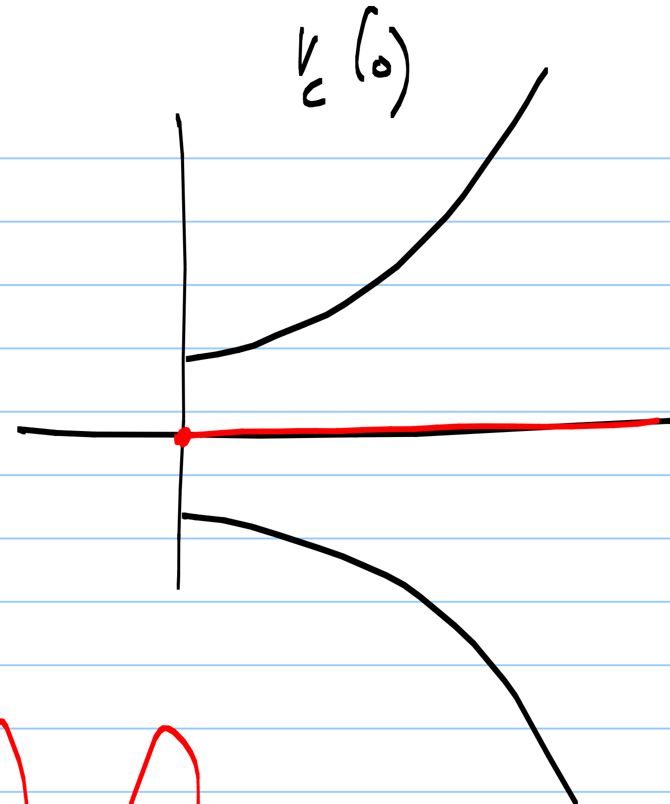
$$\frac{dI_L}{dt} + \frac{I_L}{\text{[illegible]}} = \frac{V_s}{L}$$

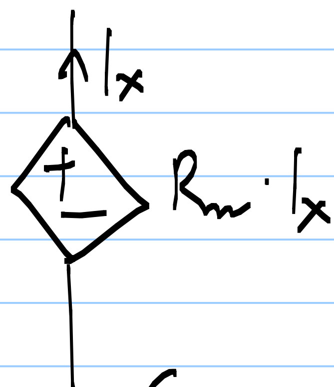
$V_o = I_L \cdot R$

$$\frac{dV_o}{dt} + \frac{V_o}{\text{[illegible]}} = V_s \cdot \frac{R}{L}$$

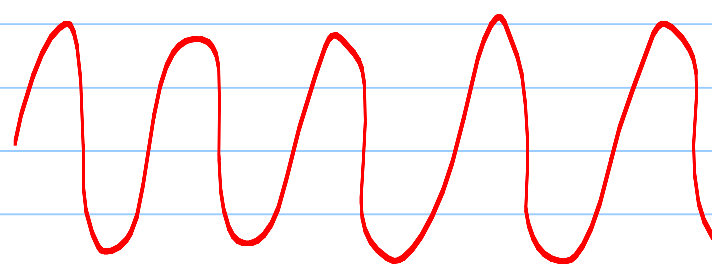


unstable system



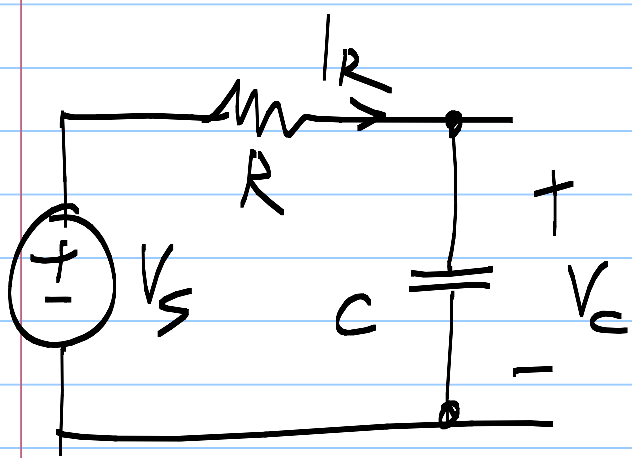


$(R_m > 0)$



First order system:

Constant inputs



$$\frac{dV_c}{dt} + \frac{V_c}{\quad} = \frac{V_s}{RC}$$

Steady-state response + Transient response

derivatives = 0

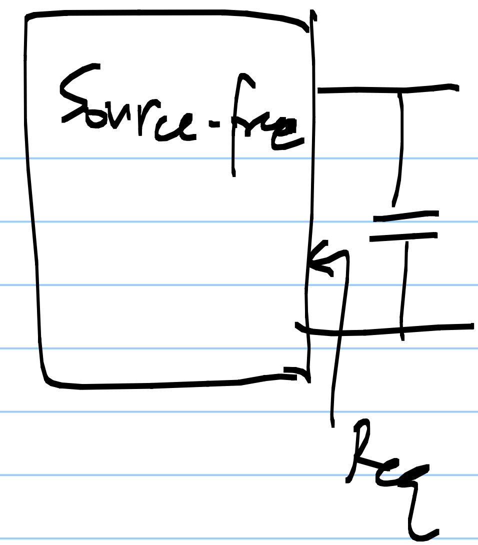
$$(\ )\exp\left(-\frac{t}{\tau}\right)$$

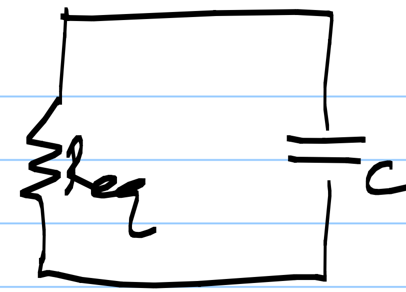
$$I_c = C\,\cancel{\frac{dV_c}{dt}}\ 0$$

$$=$$

$$V_L = L \cdot \cancel{\frac{dI}{dt}}\ 0$$

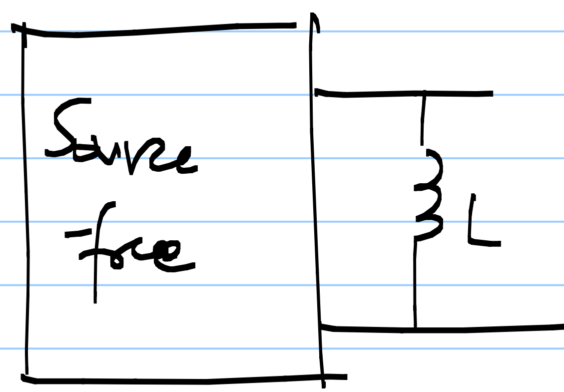
$$=$$



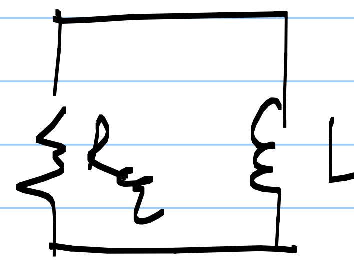


$\tau = R_{eq} \cdot C$

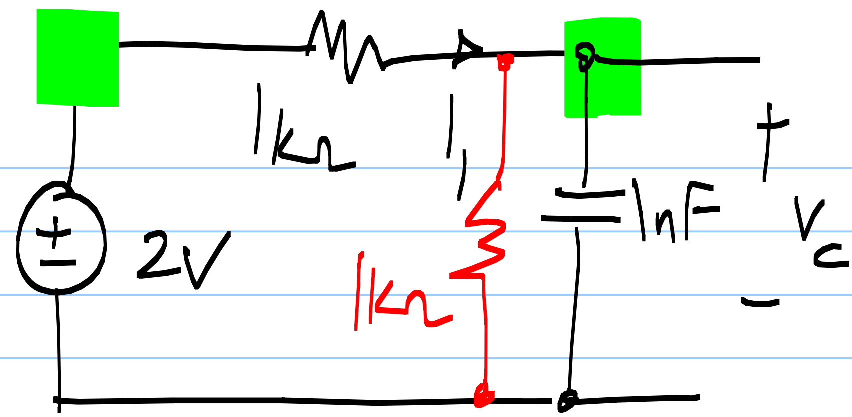
$\underline{\exp(-t/\tau)}$



$=$



$\tau = \frac{L}{R_{eq}}$



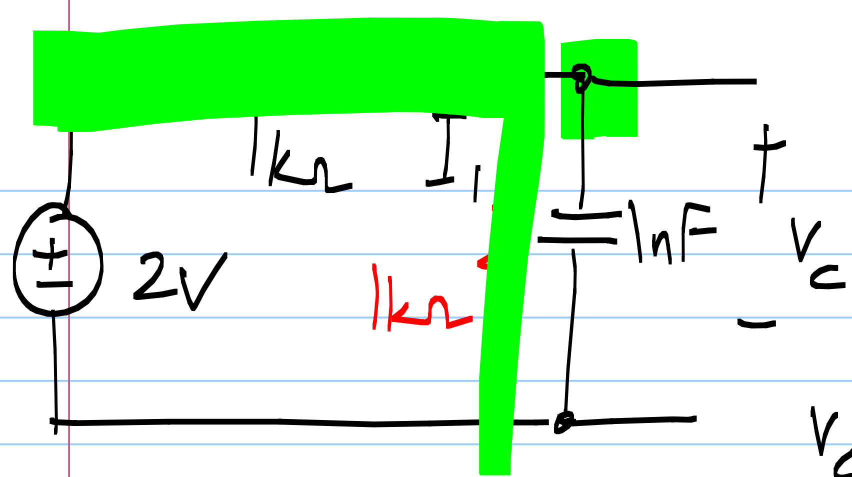
$$V_c(t) = V_c(\infty) + \left(V_c(0) - V_c(\infty)\right) \exp\left(-t/\tau\right)$$

$$V_c(0) = 1V$$

$$V_c(t) \quad 2V - 1V \cdot \exp\left(-\frac{t}{1\mu s}\right)$$

$$I_1(t) = I_1(\infty) + \left(I_1(0) - I_1(\infty)\right) \exp\left(-t/\tau\right)$$

$$0 + 1mA \exp\left(-t/1\mu s\right)$$



$$V_c(t) = 1V + (1V - 1V)\exp\left(-\frac{t}{0.5\mu s}\right)$$

$$= 1V$$

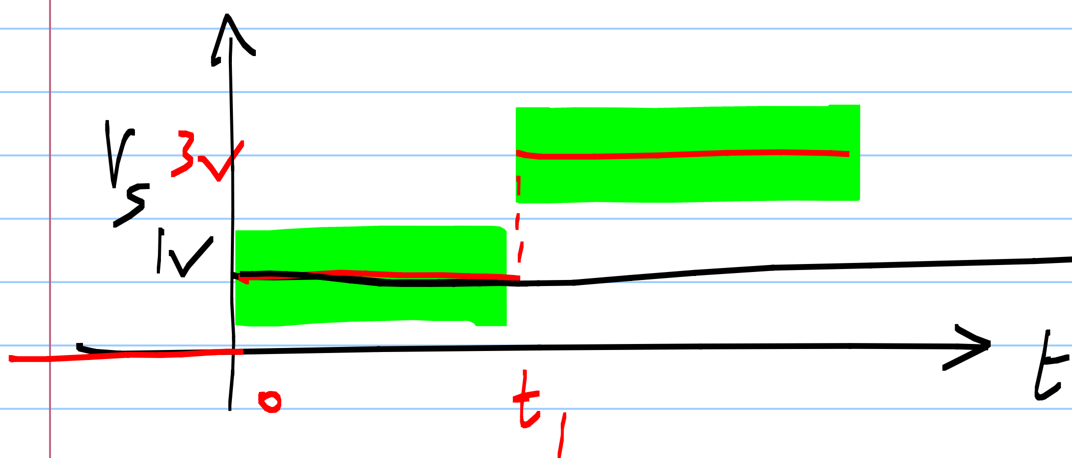
$V_c(0) = 1V$ $\quad I_1(t) = 1mA$

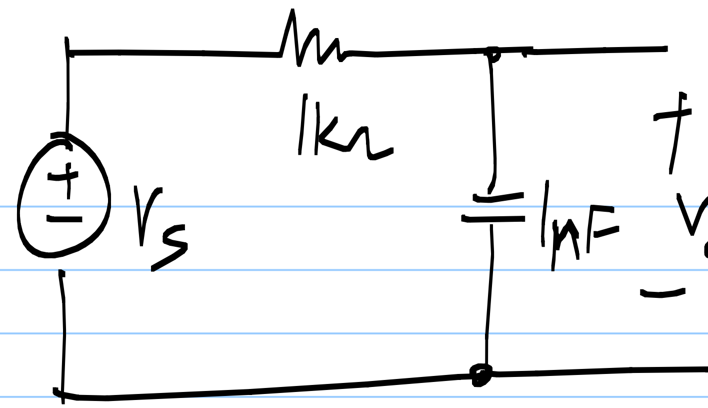
$V_c(0) = -1V$

$$V_c(t) = 1V - 2V\exp\left(-t/0.5\mu s\right)$$

$$I_1(t) = 1mA + 2mA\exp\left(-t/0.5\mu s\right)$$

Piecewise - constant





$v_c(0) = 0.5V$

$t_1 = 2ns$

$t \leq 0$: —

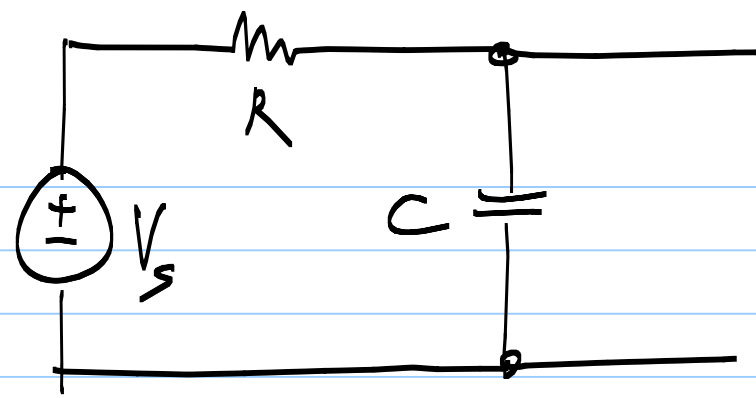
$0 < t \leq 2ns$: $1V - 0.5V \exp\left(-t/1ns\right)$

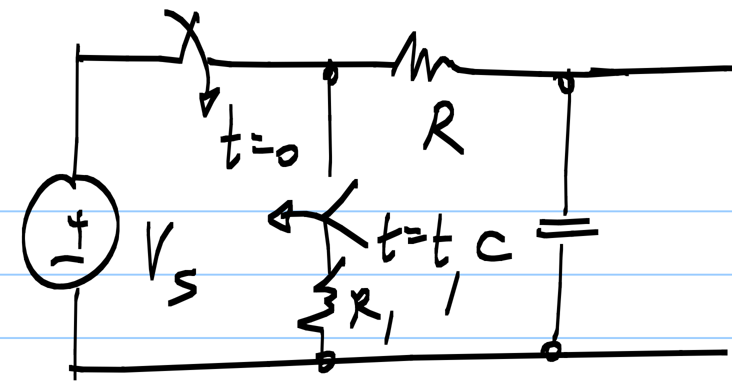
@ $t = 2ns$

$1V - 0.5V \exp(-2)$

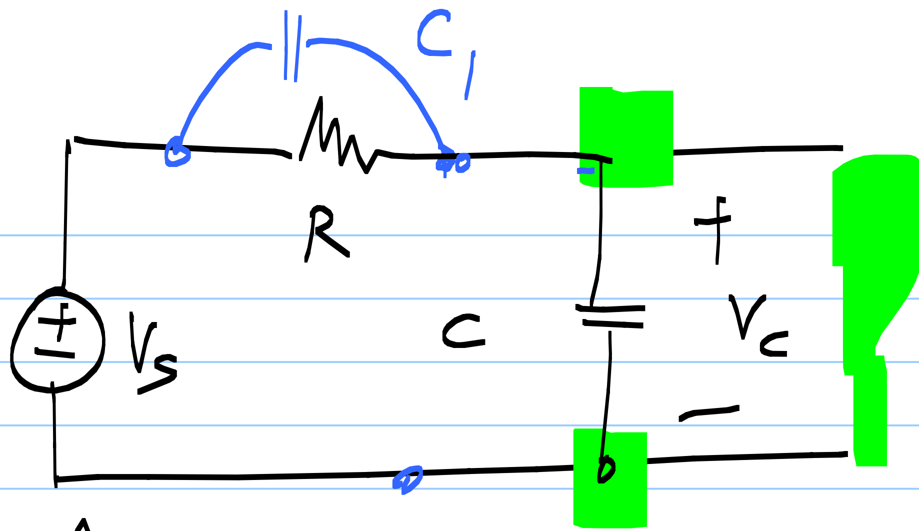
$0.932V$

$2ns < t$: $3V + (0.932 - 3V) \exp\left(-\frac{t - 2ns}{1ns}\right)$

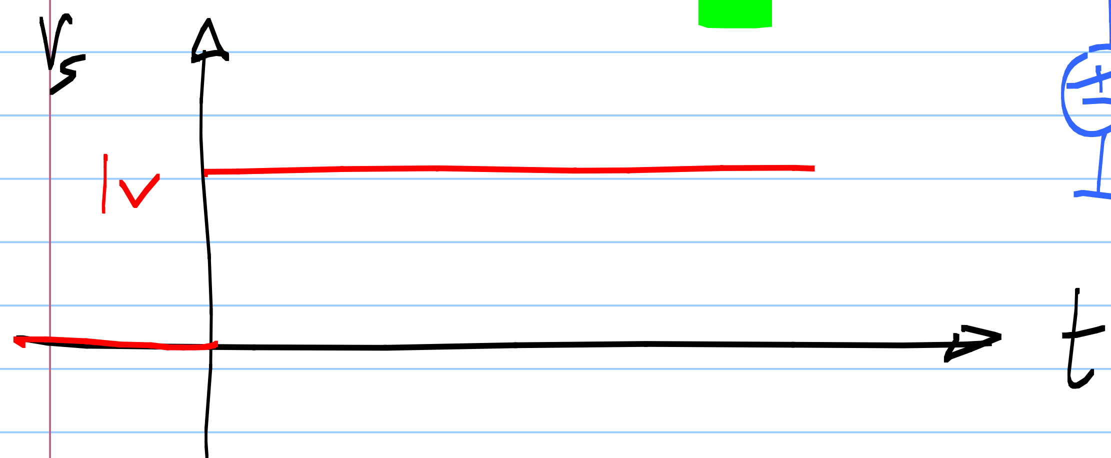

R
C
V_s

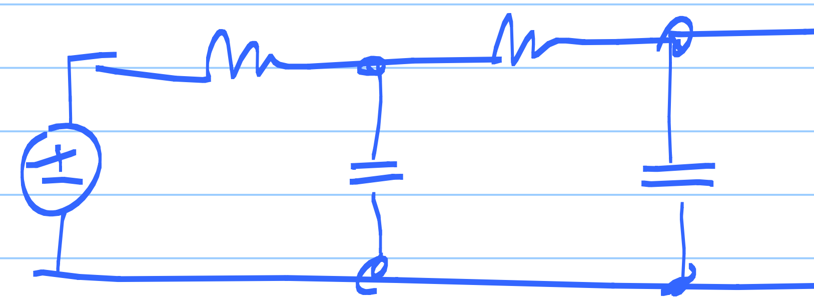

t=0
R
t=t₁
C
V_s
R_1


step.



$$V_c(t) = 1 - \exp(-t/RC)$$





$$V_c(0) = 0$$