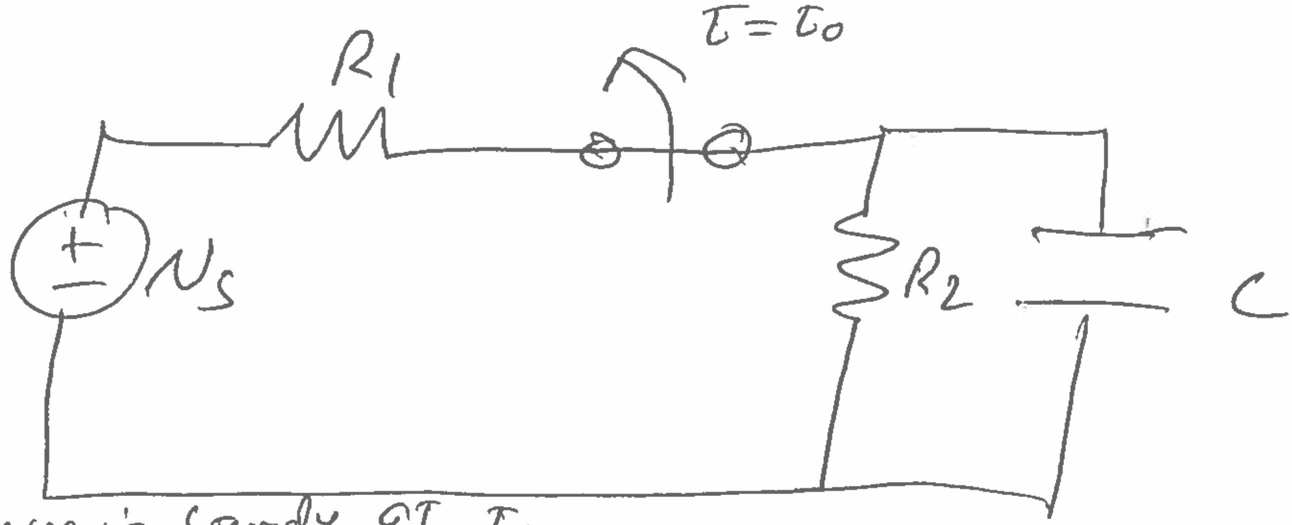
eg



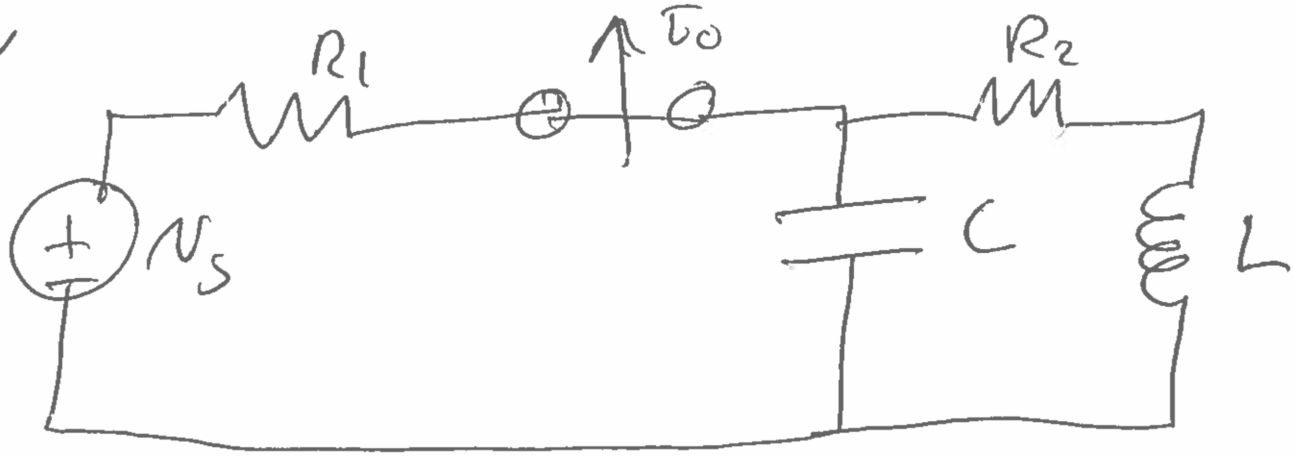
ASSUME CIRCUIT STEADY AT t_0

$$i_{R2}(t_0^-) = \frac{V_s}{R_1 + R_2} \qquad V_C(t_0^-) = i R_2 = \frac{V_s R_2}{R_1 + R_2}$$

$$i_{R2}(t_0^+) = \frac{V_s}{R_1 + R_2} = \frac{V_C}{R_2} - \frac{V_s R_2 / R_1 + R_2}{R_2}$$

$$i_{R2}(t > t_0^+) \to 0$$

eg/

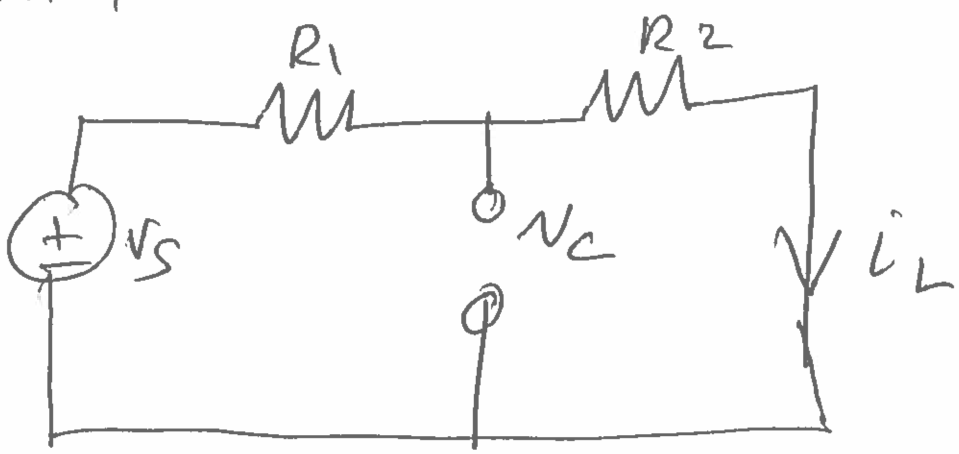


find $v_C(t_0^+)$, $i_L(t_0^+)$

$V_s = 10\ V \quad R_1 = 2\Omega \quad R_2 = 3\Omega$

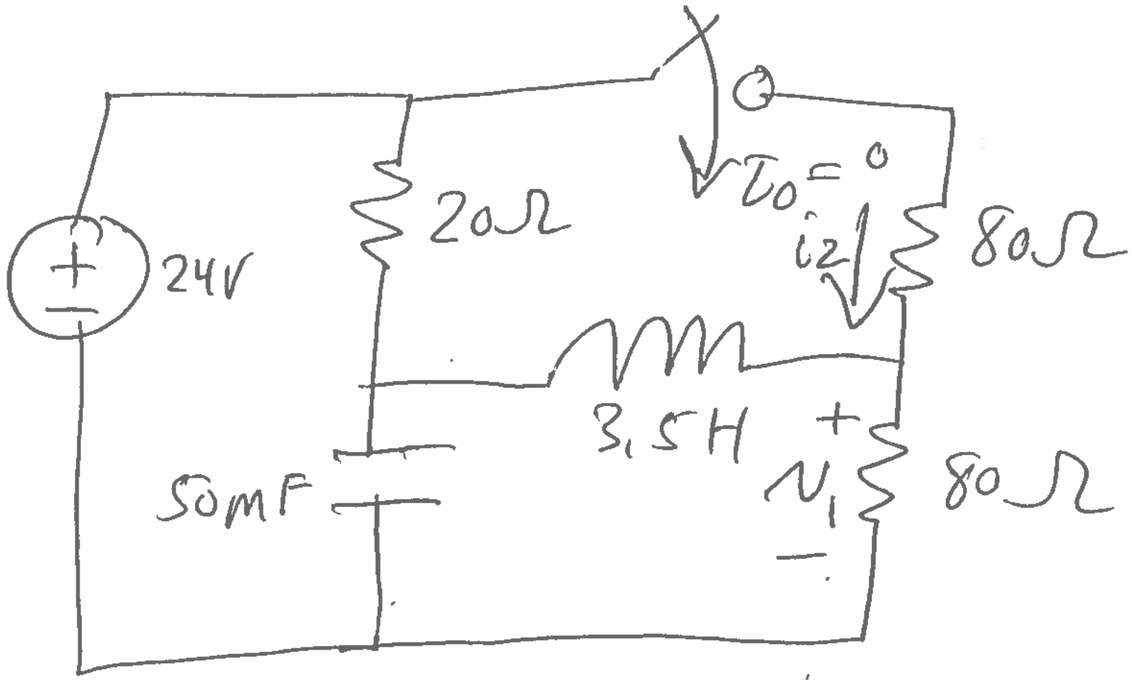
$C = 0.5F \quad L = 1H$

Steady-state before switch opens



$$i_L = \frac{10V}{2\Omega + 3\Omega} = \frac{10V}{5\Omega} = 2\ A$$

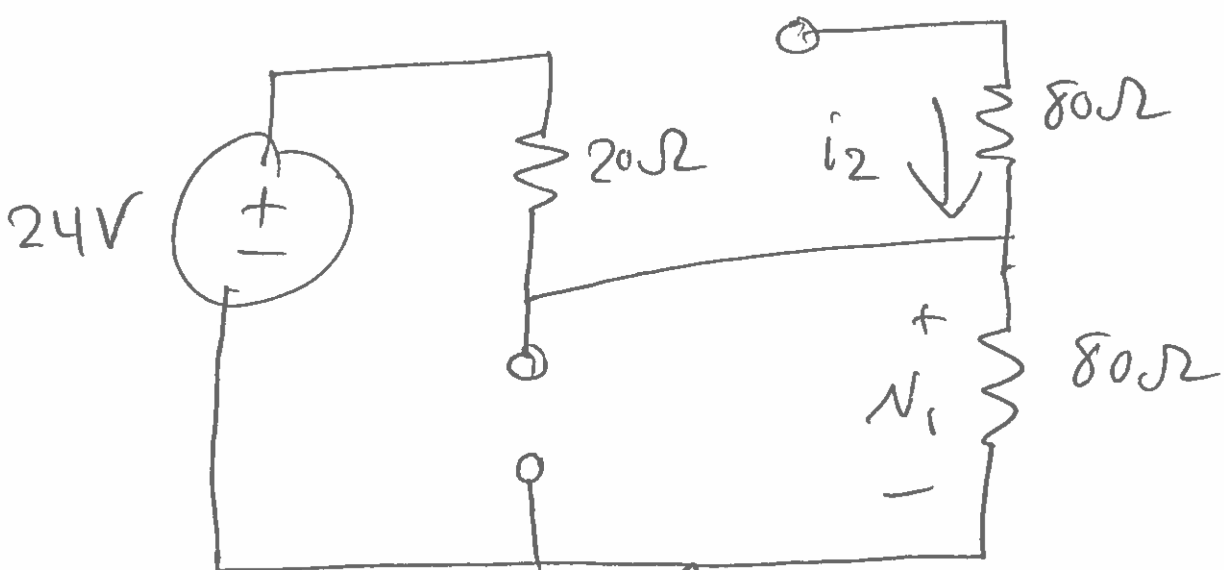
$$V_C = i_L R_2 = (2A)(3\Omega) = 6V$$



$i_2(0_s^-) = ?$ $i_2(0_s^+) = ?$

$V_1(0_s^-) = ?$ $V_1(0_s^+) = ?$

Steady state Prior To $t = 0$

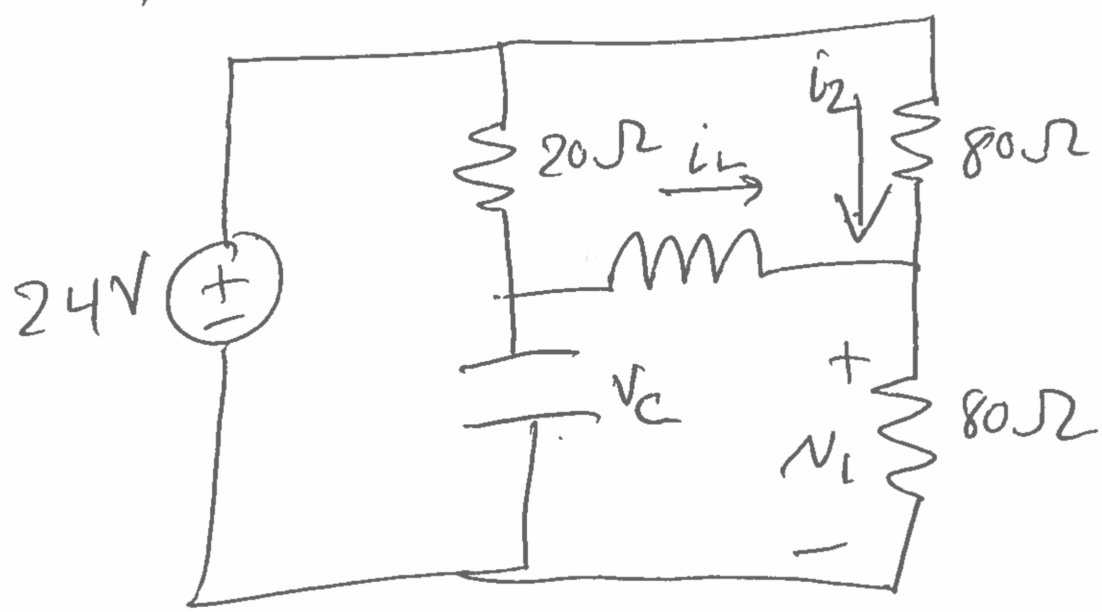


$\boxed{i_2(0^-) = 0}$

$$V_1(0^-) = 24V\left(\frac{80\,\Omega}{80\,\Omega + 20\,\Omega}\right) = .8(24\,V)$$

$$\boxed{V_1(0^-) = 19.2\,V}$$

~~Steady~~ Circuit As Switch Thrown



$$i_L = 0.24\,A \qquad V_C = 19.2\,V$$

$$\cancel{i_2 = i_L - \frac{V_1}{80\,\Omega} = 0.24\,A -}$$

0.

$$24V = i_2\,80\Omega + V_1$$

$$\cancel{i_2 = i_L - \frac{V_1}{80\Omega}}$$

$$24V = i_2\,80\Omega + V_1$$

$$\cancel{80\Omega\, i_L = 80\Omega\, i_2 + V_1}$$

$$i_L + i_2 = \frac{V_1}{80\Omega}$$

$$i_L = \frac{V_1}{80\Omega} - i_2$$

$$80\Omega\, i_L = V_1 - 80\Omega\, i_2$$

$$24V = i_2\,80\Omega + V_1$$

$$80\Omega\, i_L + 24V = 2V_1$$

$$80\Omega(.24A) + 24V = 2V_1$$

$$19.2V + 24V = 43.2V = 2V_1$$

$$\underline{V_1 = 21.6V}$$

$$i_2 = \frac{V_1}{80\Omega} - i_L$$

$$i_2 = \underbrace{\frac{21.6V}{80\Omega}}_{0.27A} - 0.24A$$

$$0.27A - 0.24A \Rightarrow i_2 = 0.03A$$

$$i_2(0^-) = 0 \quad i_2(0^+) = 0.03A$$

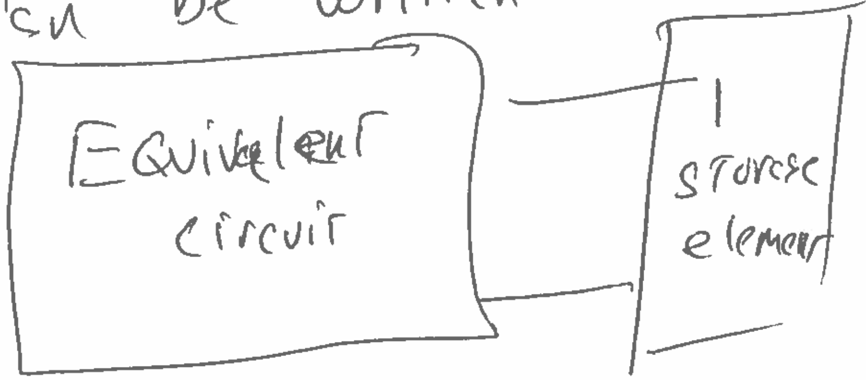
$$v_1(0^-) = 19.2V \quad v_1(0^+) = 21.6V$$

$$V_L(0^-) = 0V$$

$$V_L(0^+) = 2.4V \qquad V_L = L\frac{di}{dt}$$

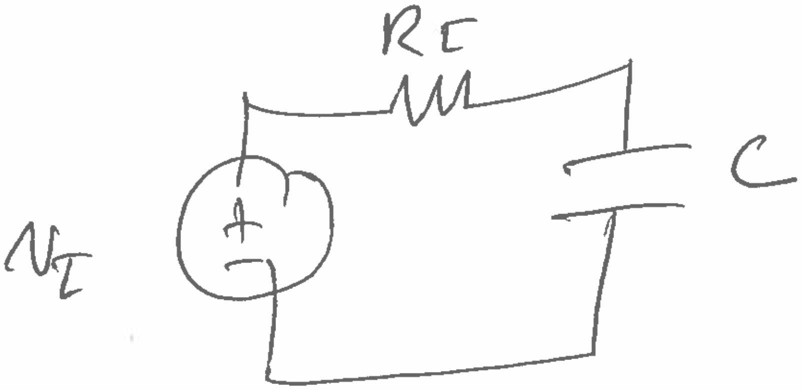
$$\frac{di_L}{dt} = \frac{2.4V}{3.5H} = 0.686$$

Many complex circuits can be written as

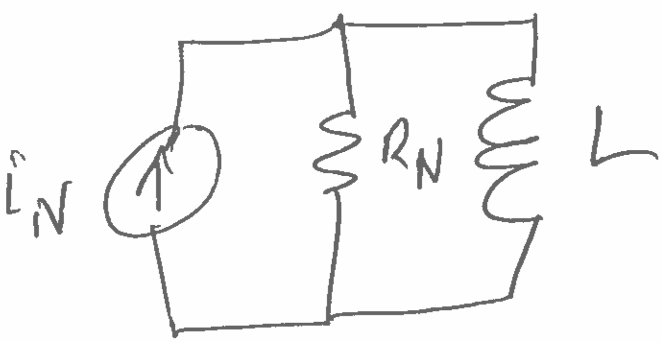


Thevenin or Norton

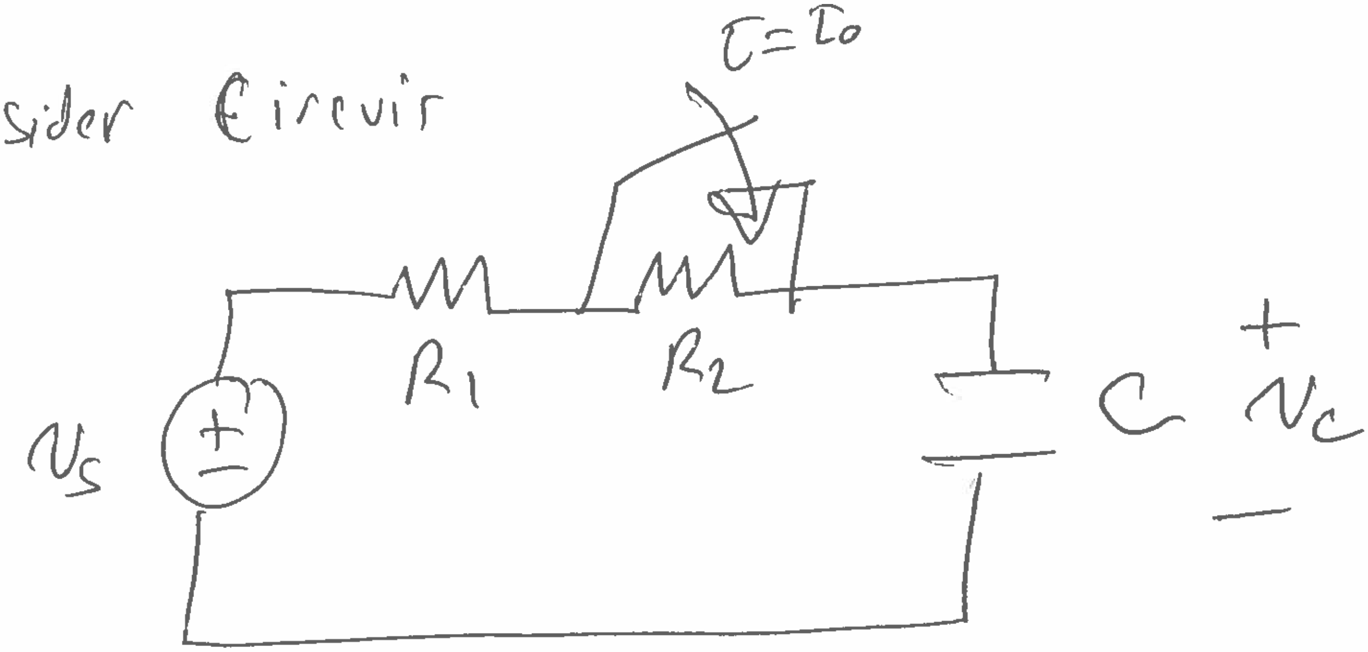
When storage is a capacitor



When storage is an inductor



Consider circuit



Flipping switch will change v_c

Complete Response has 2 parts

1) steady-state after Equilibrium is reestablished

2) transient - what happens immediately after switch is flipped

Alternatively one can consider

1) Natural response

2) Forced response

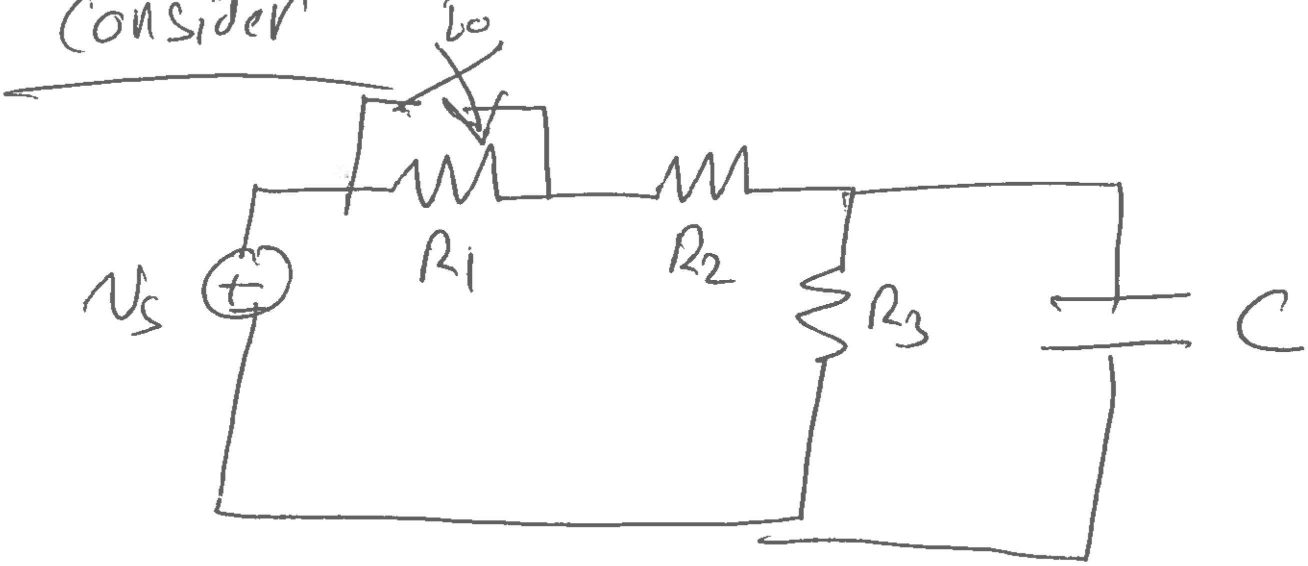
We consider 3 forcings

1) Constant voltage – switch flip

2) exponential functions

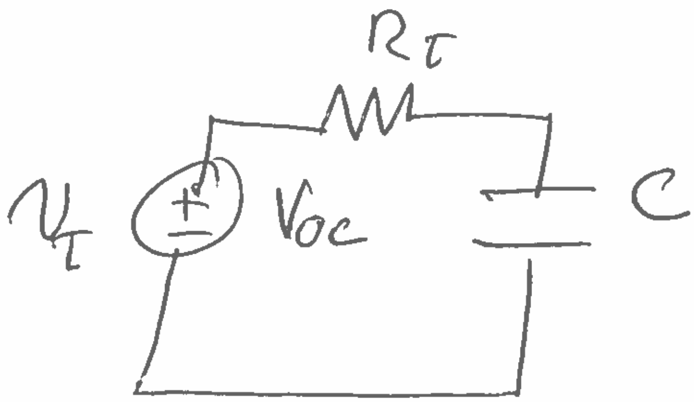
3) sinusoidal functions.

Consider



When Switch Thrown Circuit becomes

$$V_C(t_0^-) = \frac{V_S R_3}{R_1 + R_2 + R_3}$$



$$R_T = \frac{R_2 R_3}{R_2 + R_3}$$

$$V_T = V_{oc} = V_S\left(\frac{R_3}{R_2 + R_3}\right)$$

Do a voltage walk

$$V_{oc} - i R_T - V_c = 0$$

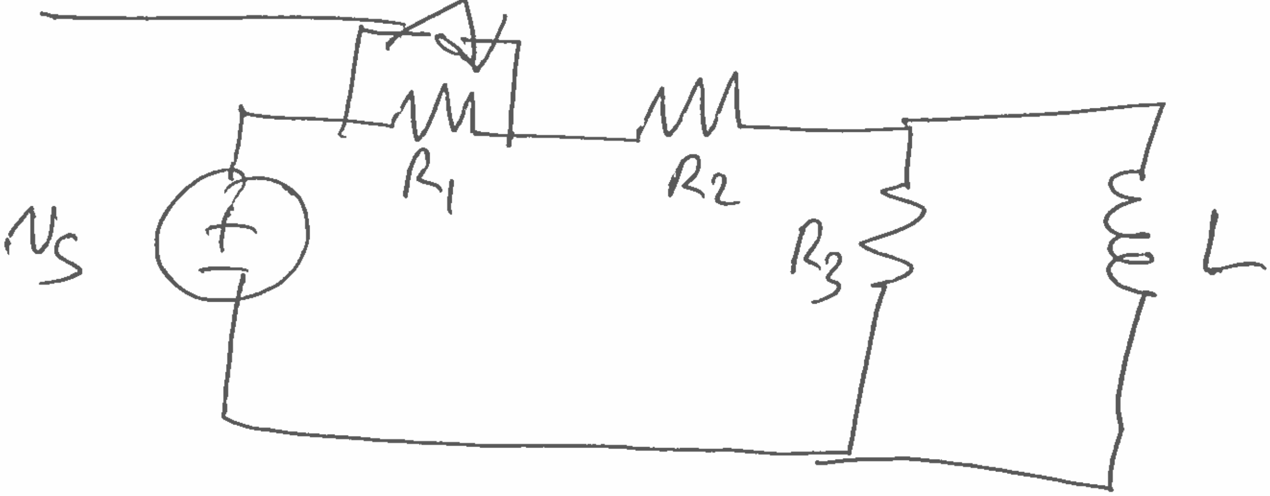
$$i = i_c = C \frac{dV_c}{dt}$$

$$V_{oc} - R_T C \frac{dV_c}{dt} - V_c = 0$$

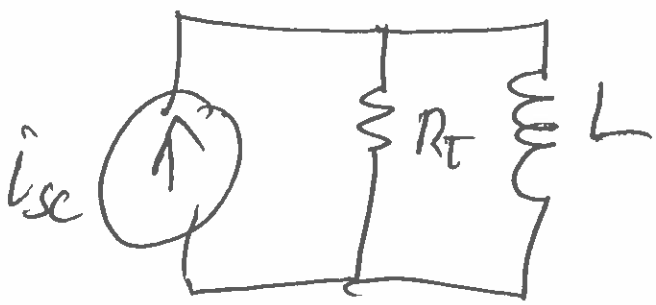
$$\frac{dV_c}{dt} + \frac{1}{R_T C} V_c = \frac{V_{oc}}{R_t C}$$

$$\boxed{\frac{d\,x(t)}{dt} + \frac{x(t)}{\tau} = K}$$

consider t_0



after switch thrown



$$i_s = \frac{v_s}{R_2} \qquad R_t = \frac{R_2 R_3}{R_2 + R_3}$$