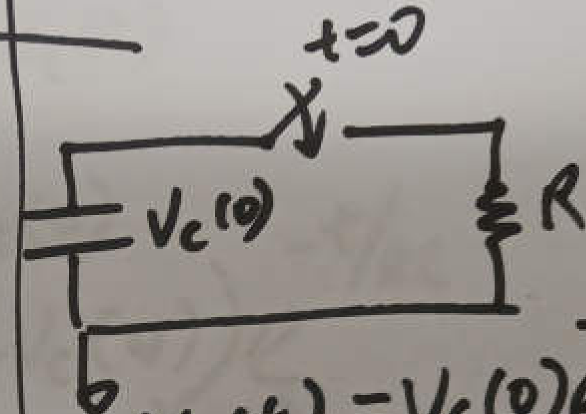
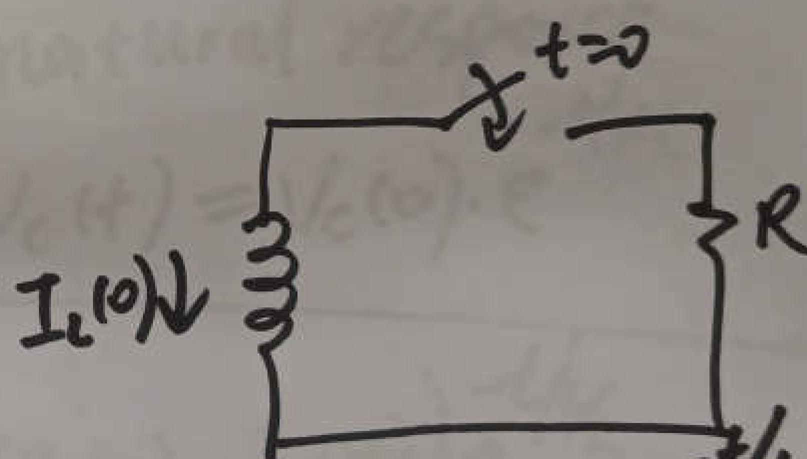
Time constant

RC

$\frac{L}{R}$

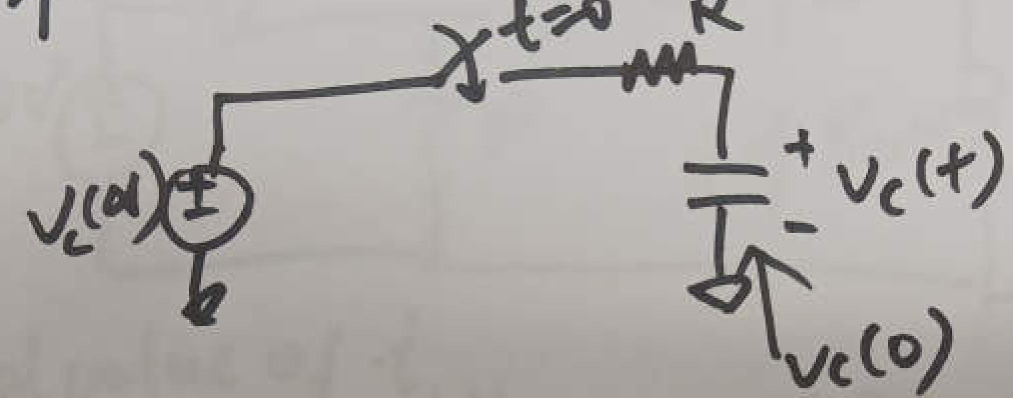


$$V_c(t) = V_c(0)e^{-t/RC}$$



$$I_L(t) = I_L(0)\cdot e^{-t/\frac{L}{R}}$$
$$= I_L(0)\cdot e^{-\frac{R}{L}t}$$

step response



$$V_c(t) = V_c(\infty) + (V_c(0) - V_c(\infty))e^{-t/RC}$$

Two special cases

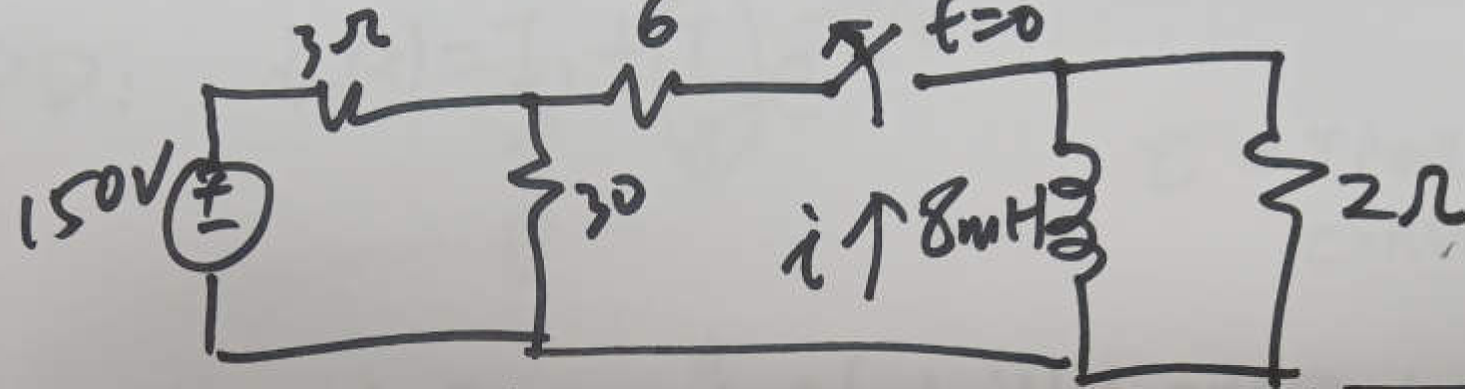
if $v_c(0) = 0 \rightarrow V_c(t)\,(1 - e^{-t/RC})$

if $v_c(\infty) = 0 \rightarrow$ natural response

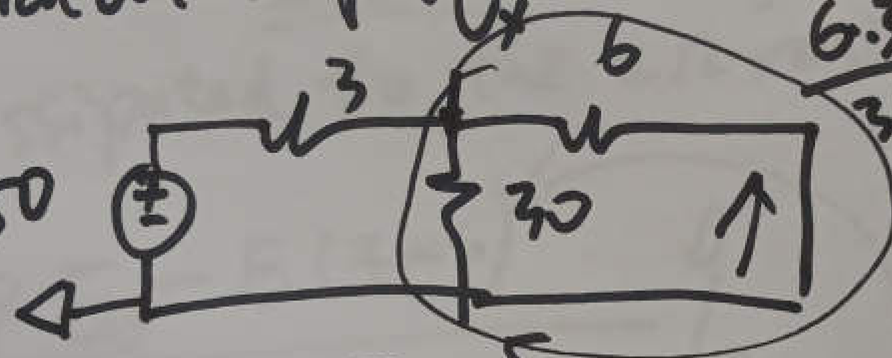
$$V_c(t) = V_c(0) \cdot e^{-t/RC}$$

step response for inductors:

$$I_L(t) = I_L(\infty) + (I_L(0) - I_L(\infty))e^{-t/L/R}$$



PA: initial value of i



$\frac{6\cdot 30}{36} = 5\Omega$

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

$Vx = 150\cdot\frac{5}{3+5} =$

L can't change current instantaneously

PB: initial energy in inductor

$w_0 = E = \frac{1}{2}L\cdot I^2$

$I_L(0^-) = I_L(0^+)$

PC: time constant for $t > 0$.

$\frac{L}{R} = \frac{8mH}{2} = 4ms$

PD: $i_o(t) = I_1 + I_2 e^{-t/\tau}$

$I_1 \to 0$

τ = Time constant

PE: at $t = 3ms$, % of initial energy dissipated to the 2Ω resistor.

$$\frac{E_0 - E(3ms)}{E_0} \%$$

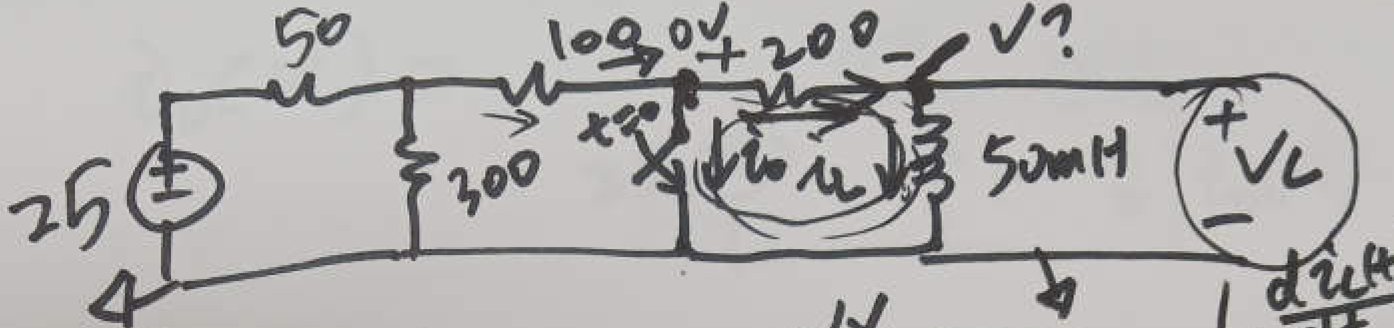
$E_0 = \frac{1}{2} \cdot L \cdot I_L^2(0)$

$E(3ms) = \frac{1}{2} L \cdot I_L^2(3ms) = \frac{1}{2} L \left(I_L(0) \cdot e^{-t/4R} \right)^2$

3ms

0.003

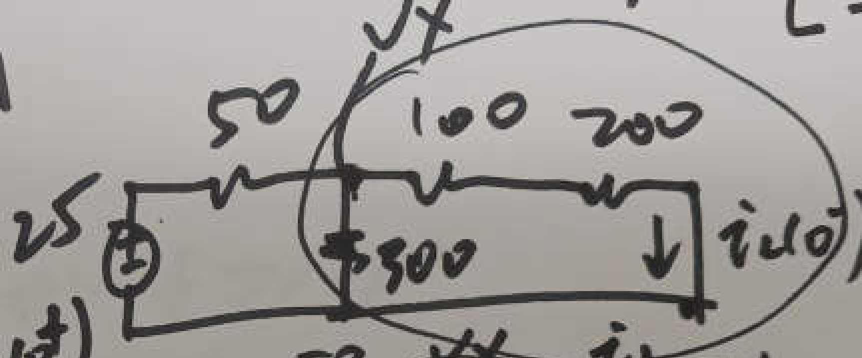
④



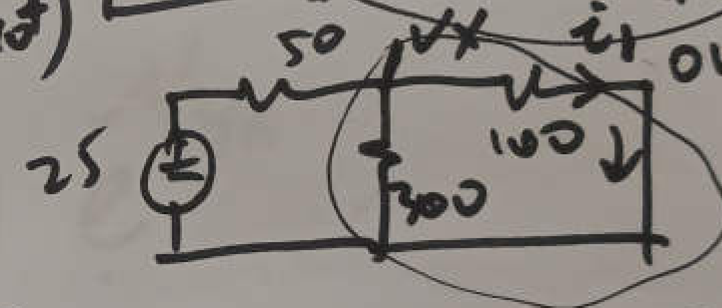
$L\frac{di_L(t)}{dt} = V_L(t)$

$i_0(0^-) = 0$ A

$i_L(0^-) =$



$\boxed{i_0(0^+)} = i_1 - i_L(0^+)$



$\frac{100 \cdot 300}{400} = \frac{30000}{400} = 75\ \Omega$

$$\boxed{i_L(0^+) = i_L(0^-)}$$

$Vx = 25 \cdot \frac{75}{75+50}$

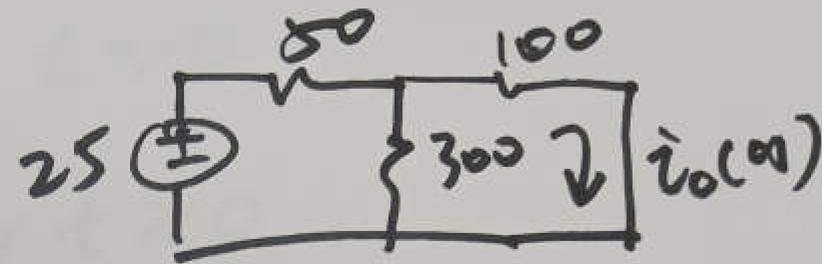
$V_L(t) = L\frac{di(t)}{dt}$

$i_1 = \frac{Vx - 0}{100}$

$i(t) = \frac{1}{L}\int V_L(t)\,dt$

5

$i_0(\infty) =$



$i_L(\infty) =$

$i_L(t)$ for $t \geq 0$

$= i_L(0) \cdot e^{-t/4k}$

$v_L(0^-) = 0V.$

$v_L(0^+) =$

$v_L(\infty) =$

(b)

$v_L(t)$ for $t \geq 0$

$i_0(t)$ for $t \geq 0$

(b)