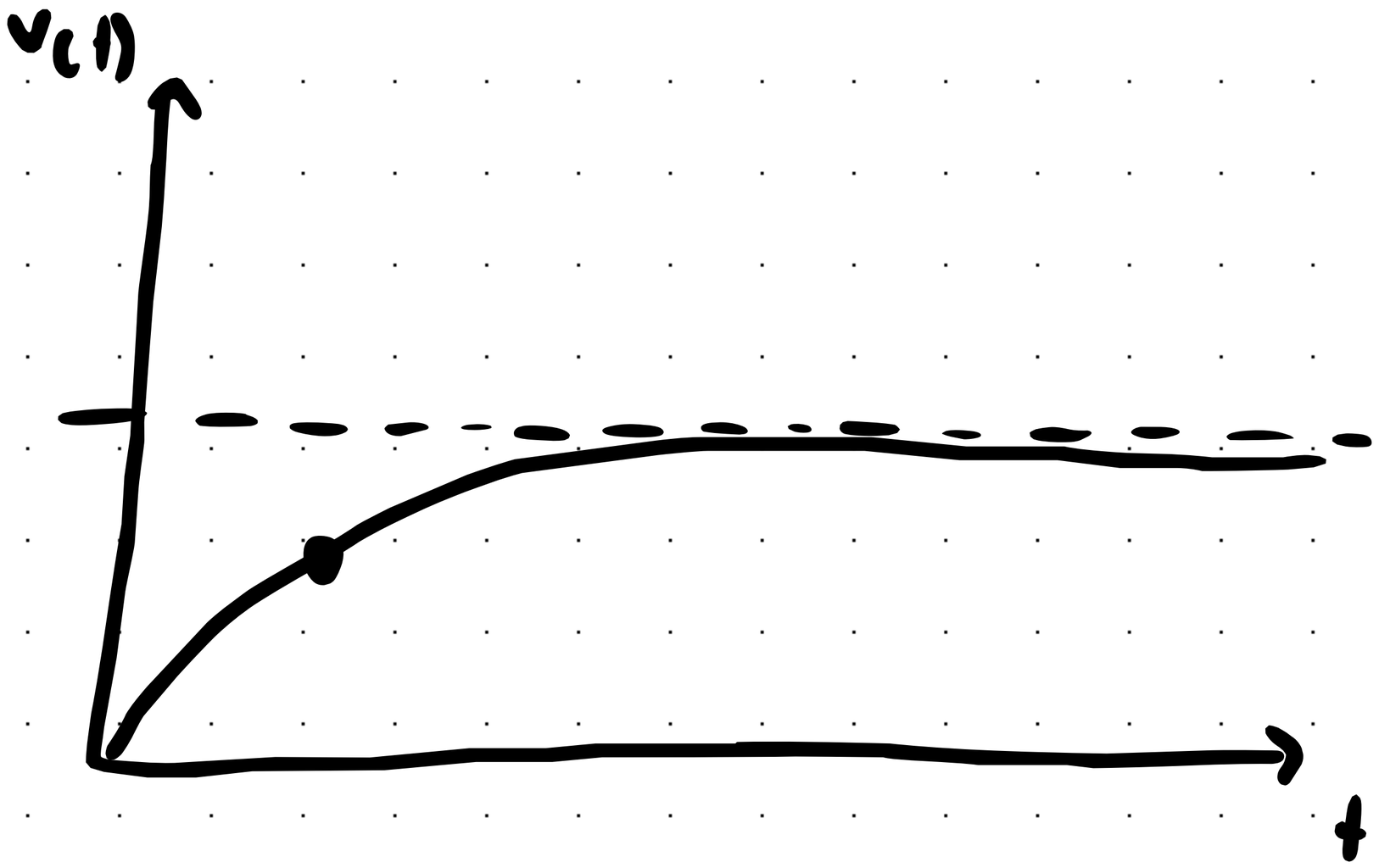
Tutorial 7

Time Constant

Time taken to reach to about 63.2% of full value of final



For R-C Circuit

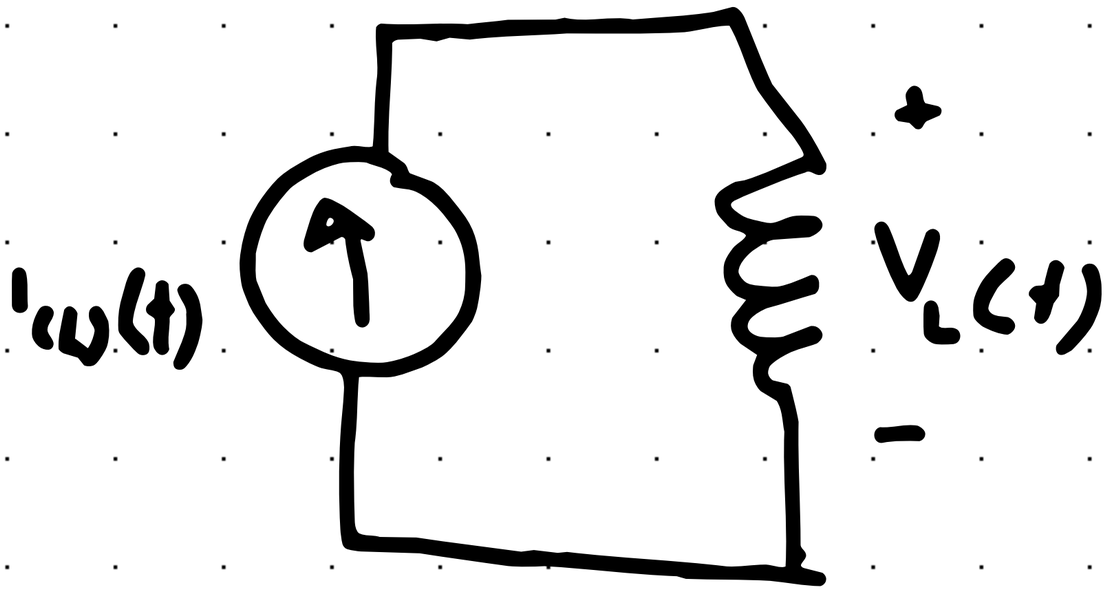
$\tau = RC$

↳ Time Constant

Ex)

$i(t) = 10te^{-5t}$, $t > 0$

Find $v_L(t)$, $P_L(t)$ and $W_L(t)$



$W = \int p\,dt$, or $\frac{1}{2}Li^2$

Solution

voltage

$$V_L(t) = L\frac{di}{dt} \quad 100\times10^{-3}\ \frac{d(10te^{-5t})}{dt}$$

$$(uv)' = u'v + v'u$$

$$V_L(t) = 0.1\left[10e^{-5t} + 10t(-5)e^{-5t}\right] =$$

$$V_L(t) = e^{-5t} - 5te^{-5t}$$

Power

$$P_{(t)} = V_{(t)}\, i_{(t)} =$$

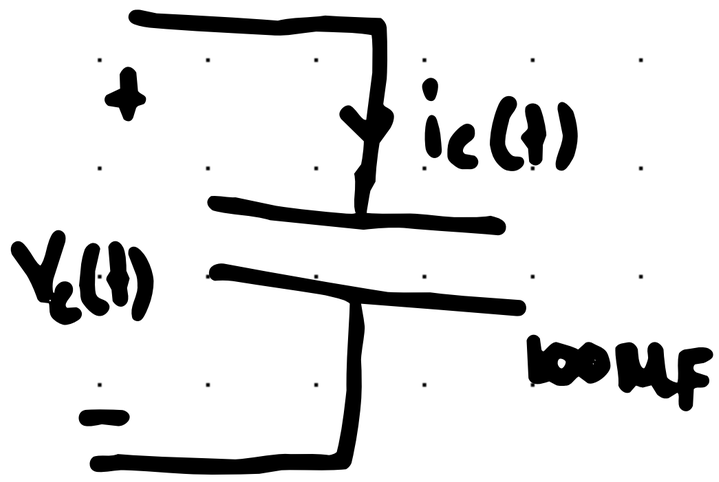
$$= 10te^{-10t} - 50t^2e^{-10t}$$

Energy

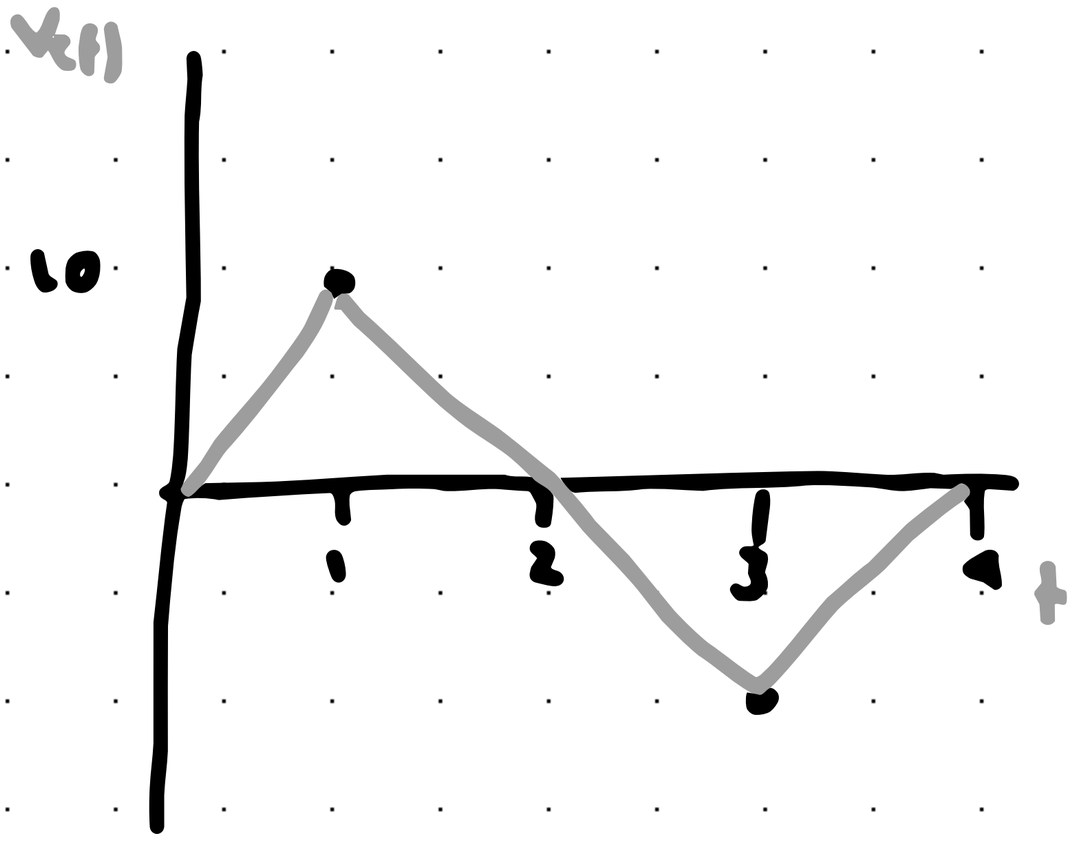
$$W_{(t)} = \int p\,dt$$

$$\int 10te^{-10t} - 50t^2e^{-10t}\,dt = 5t^2e^{-10t}$$

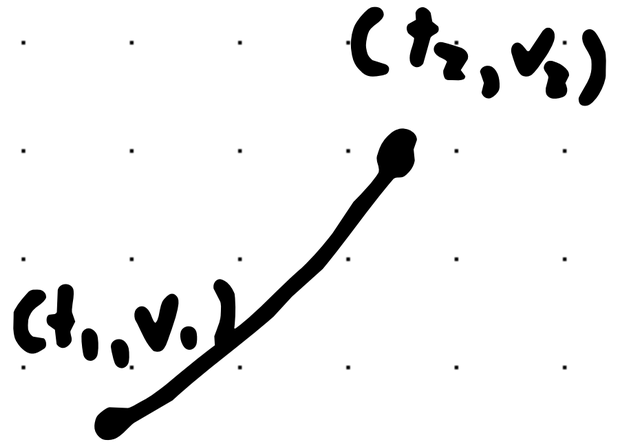
Ex)



Solution



$$V(t) = \begin{cases} 10{,}000t & 0 \le t < 1ms \\ 0.02 - 10{,}000t & 1 \le t < 3ms \\ -0.01 + 10{,}000t & 3 \le t < 9ms \\ 0 & t \ge 9ms \end{cases}$$



$$\frac{v_2 - v_1}{t_2 - t_1} = m$$

was solved

$$i_c(t) = C\frac{dv}{dt}$$

$$C = \frac{1}{10000} \quad \frac{dv}{dt} = 10{,}000$$

$$i_c(t) = \begin{cases} 1 & 0 \le t < 1ms \\ -1 & 1 \le t < 3ms \\ 1 & 3 \le t < 4ms \\ 0 & t \ge 9ms \end{cases}$$