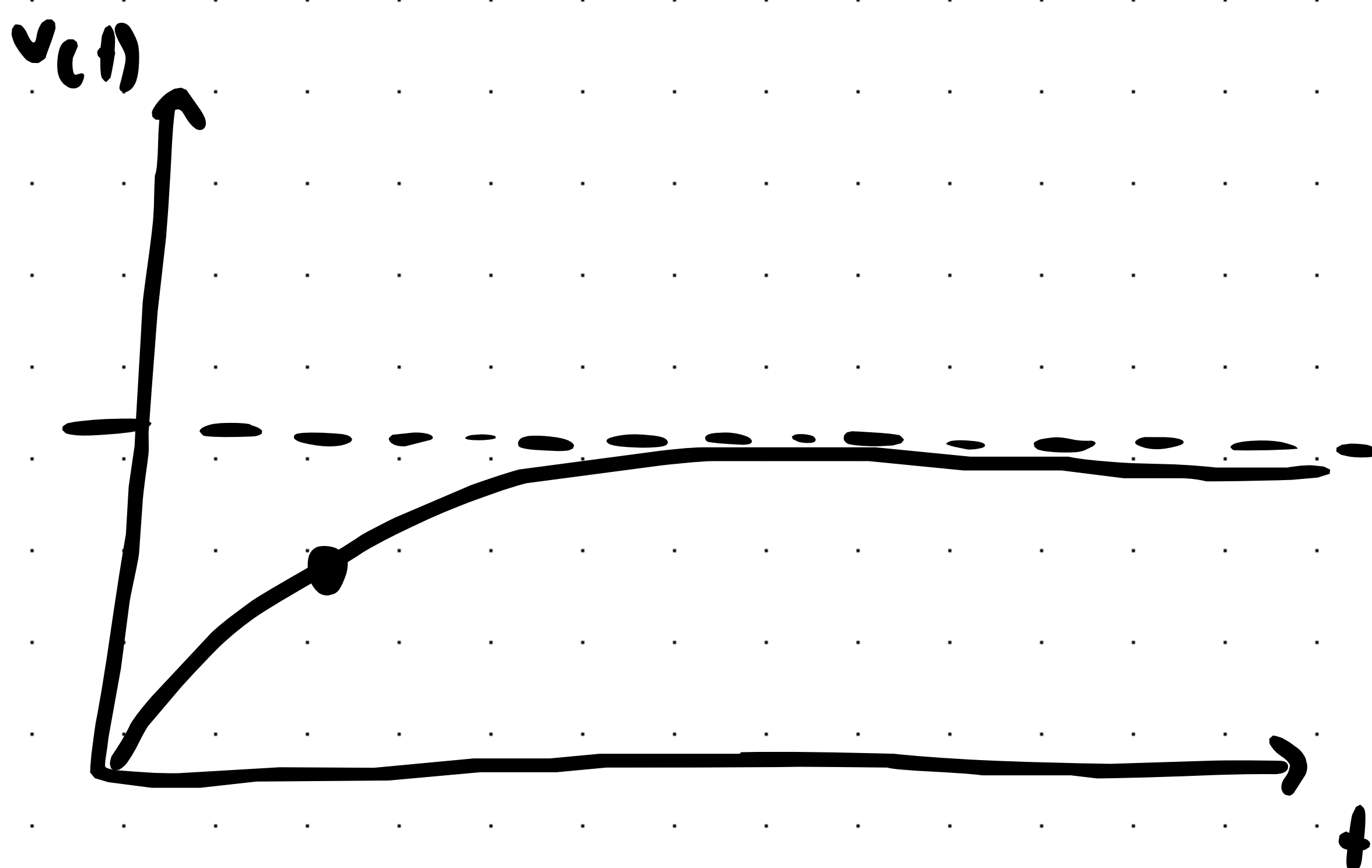


Tutorial 7

Time Constant

Time taken to reach to about

63.2% of full value of function



For R-C Circuit

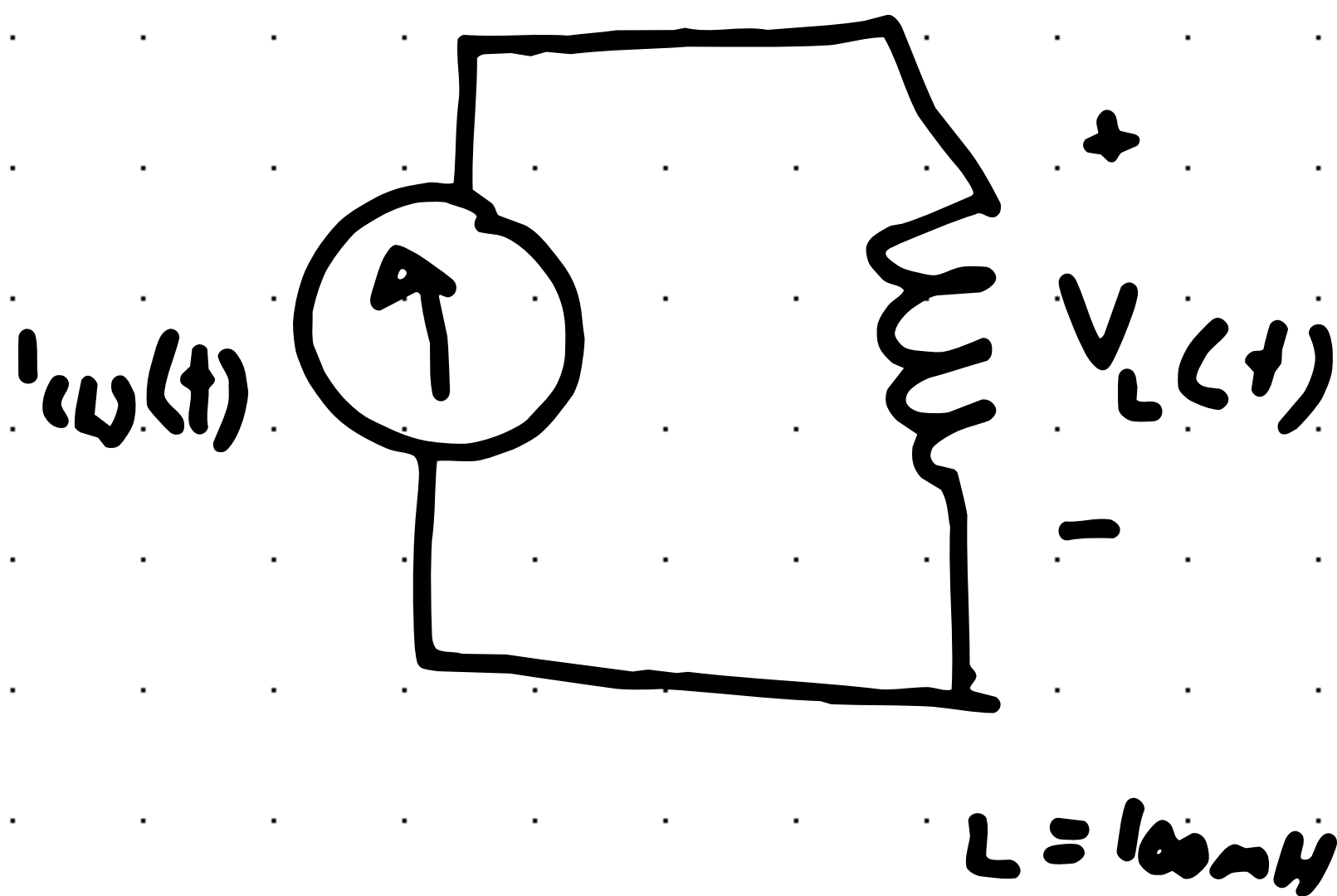
$$\tau = RC$$

↑ Time Constant

Ex)

$$i(t) = 10t e^{-5t}, \quad t \geq 0$$

Find $v_L(t)$, $p_L(t)$ and $w_L(t)$



$$W = \int p dt, \text{ or } \frac{1}{2} L i^2$$

Solution

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

Volts

$$v_L(t) = L \frac{di}{dt} = 100 \times 10^{-3} \frac{d(10t e^{-5t})}{dt}$$

$$v_L(t) = 0.1 [10 e^{-5t} + 10t(-5)e^{-5t}] =$$

$$\underline{v_L(t) = e^{-5t} - 5t e^{-5t}}$$

Power

$$p(t) = v(t) i(t) =$$

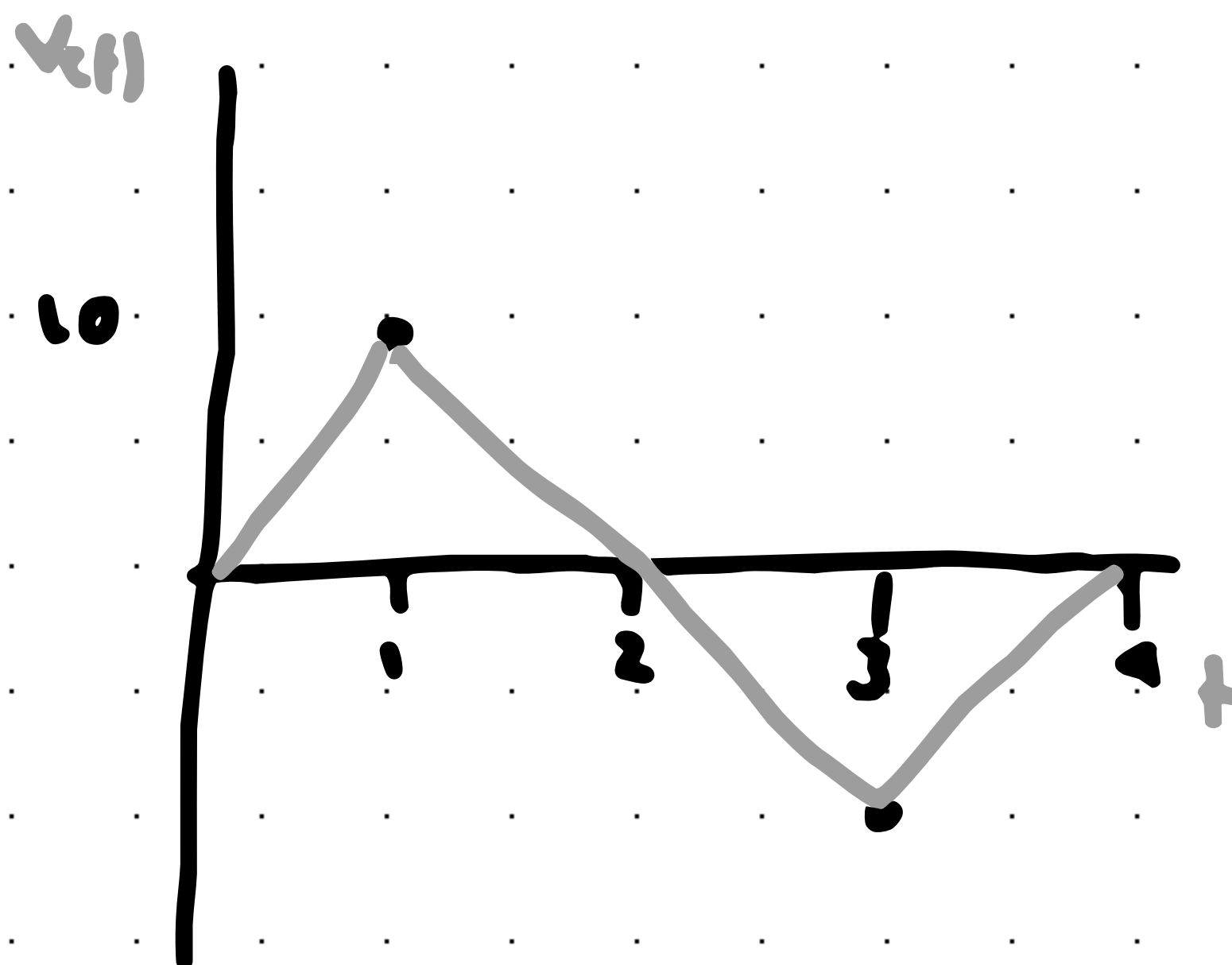
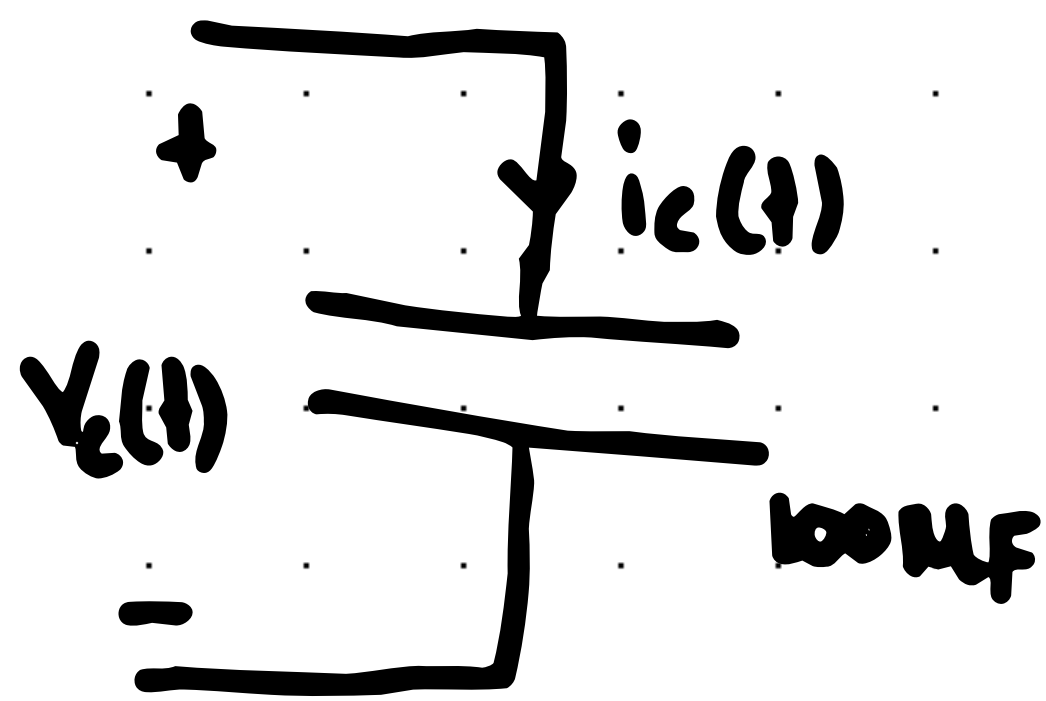
$$= 10t e^{-10t} - 50t^2 e^{-10t}$$

Energy

$$w(t) = \int p dt$$

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

Ex)



Solution

$$v(t) = \begin{cases} 10,000t & 0 \leq t < 1\text{ms} \\ 0.02 - 10,000t & 1 \leq t < 3\text{ms} \\ -0.01 + 10,000t & 3 \leq t < 4\text{ms} \\ 0 & t \geq 4\text{ms} \end{cases}$$

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

↑ was solved

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

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

$$i_c(t) = \begin{cases} 1 & 0 \leq t < 1\text{ms} \\ -1 & 1 \leq t < 3\text{ms} \\ 1 & 3 \leq t < 4\text{ms} \\ 0 & t \geq 4\text{ms} \end{cases}$$