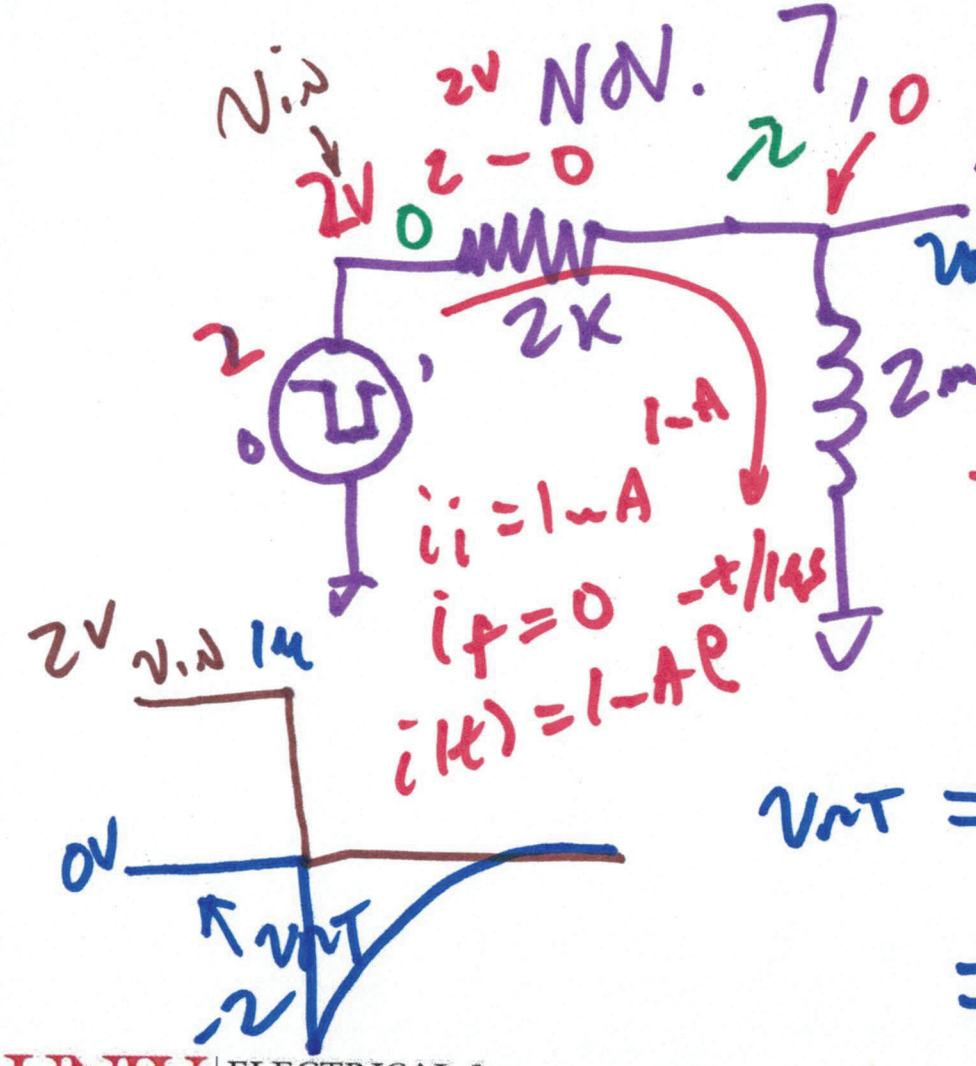
EE 220 CIRCUITS I

Lecture 19

NOV. 7, 10 2022

$\frac{-A}{B} = -\frac{A}{B} = \frac{A}{-B}$



$v_{out} = ?$

$i = ?$

$\frac{L}{R} = \frac{2mH \cdot 10^{-3}}{2K \cdot 10^{-3}}$

$= 1\mu s$

$I(0^-) = 1-A$

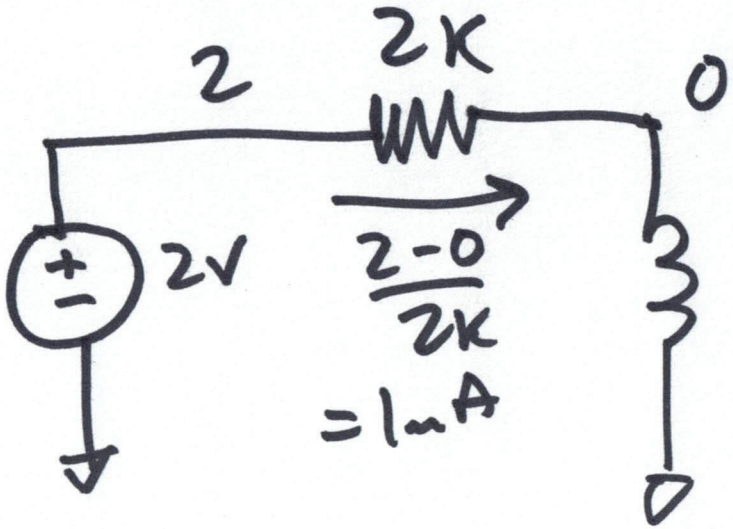
$I(0) = 1-A$

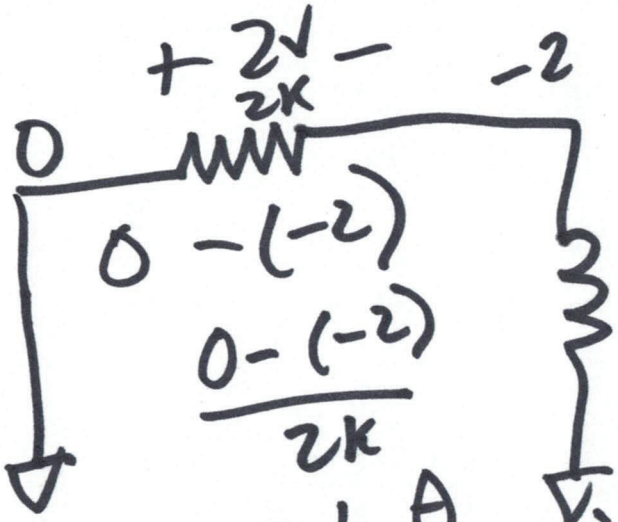
$I(0^+) = 1-A$

$v_{out} = v_f + (v_i - v_f)e^{-\frac{(t-1\mu)}{1\mu}}$

$= -2e^{-\frac{(t-1\mu)}{1\mu}}$

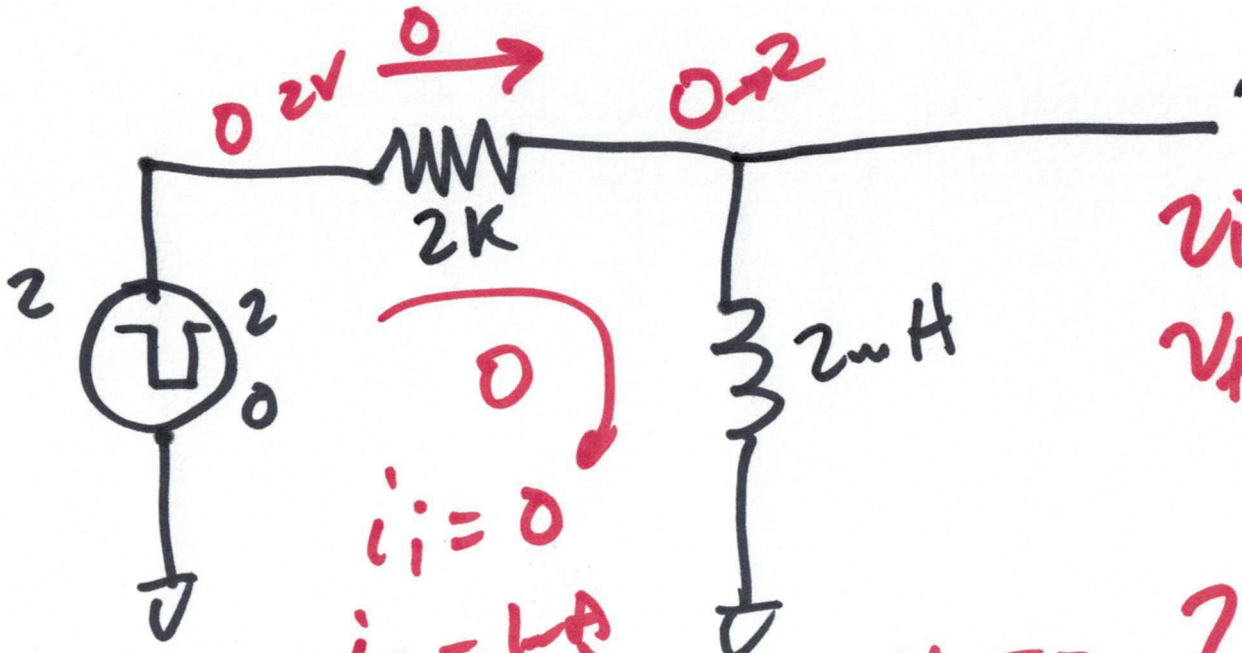
$t \geq 1\mu s$





$v_{out}(0^-) = 0$

$v_{out}(0^+) = -2 = v_i$



$v_i = 2V$

$v_f = 0$

$i_i = 0$

$i_f = 1mA\left(1 - e^{-\frac{(t-t_{ST})}{1\mu}}\right)$

$\frac{2-2P}{2K}$

$v_{OUT} = 2e^{-\frac{(t-t_{ST})}{1\mu}}$

$i(t) = 1mA\left(1 - e^{-\frac{(t-t_{ST})}{1\mu}}\right)$

$= 1mA - 1mAe^{-\frac{(t-t_{ST})}{1\mu}}$

Energy, $\mathcal{E}$

$$\mathcal{E} = \int_{t_1}^{t_2} v(t) \cdot i(t) \cdot dt$$

$p(t)$ = instantaneous power, WATTS

$= v(t) \cdot i(t)$

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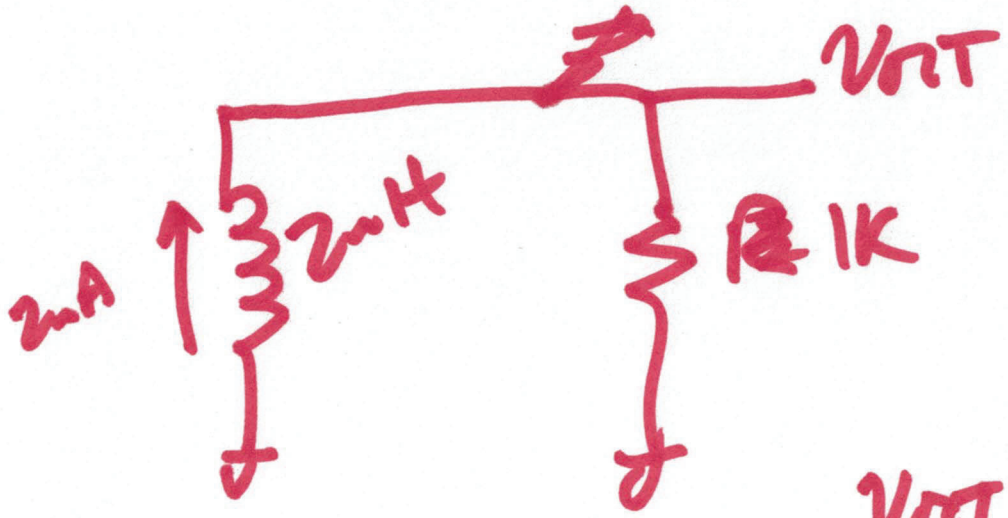
inductor

$$V = L \cdot \frac{di}{dt} \Rightarrow \mathcal{E} = \int_0^t L \cdot \frac{di(t)}{dt} \cdot i(t) \cdot dt$$

$$= L \int_0^I i(t) \cdot di(t)$$

$$\boxed{\mathcal{E} = \frac{1}{2} L I^2}$$



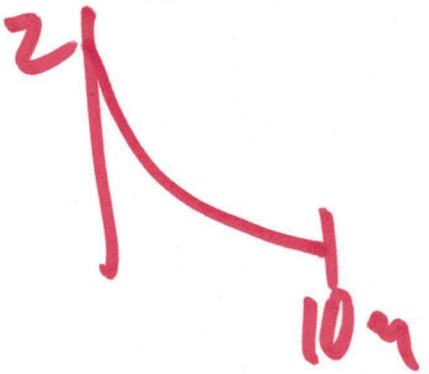
$v_i = 2V$

$v_f = 0$

$v_{OUT} = v_f + (v_i - v_f)e^{-t/4R}$

$-t/2\mu s$

$= 2e$



$E = \frac{1}{2}LI^2$

$= \frac{1}{2} \cdot 4mH(2mA)^2$

$= 4 \cdot 10^{-3} \cdot 10^{-6}$

$= 4\,nJ$

Capacitor

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

$$\mathcal{E} = \int_{t_1}^{t_2} \underbrace{v(t)\cdot i(t)}_{p(t)} \cdot dt$$

$$= \int_{v_1}^{v_2} v(t) \cdot C \cdot \frac{dv(t)}{dt} \cdot dt$$

$$= \frac{1}{2} C V^2 \Big|_{V_1}^{V_2}$$

$$\mathcal{E} = \frac{1}{2}C(V_2 - V_1)^2 = \frac{1}{2}C\Delta V^2$$

$$\mathcal{E} = \frac{1}{2}CV^2$$

0

$10^3 \cdot 10^{-12} = 10^{-7}$

$$\mathcal{E} = \frac{1}{2}(1{,}000\,pF)\cdot 5^2$$

$$\mathcal{E} = 12.5\,nJ$$