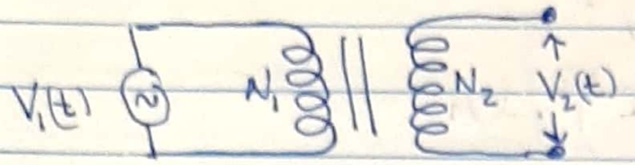
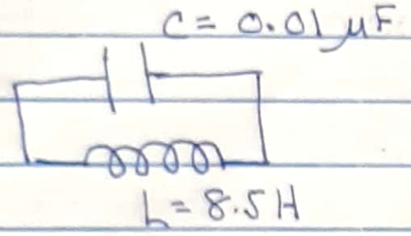
Flashcards for Exam 3 Part 5



If $N_1 = 10$ and $N_2 = 5000$ and $V_1(t) = 170\text{ Volts}\cos(\omega t)$ and $V_2(t) = \mathcal{E}_2\cos(\omega t)$, what is $\mathcal{E}_2$?

$$\mathcal{E}_2 = \frac{5000}{10} \cdot 170\text{ Volts} = 85\text{ kV}$$

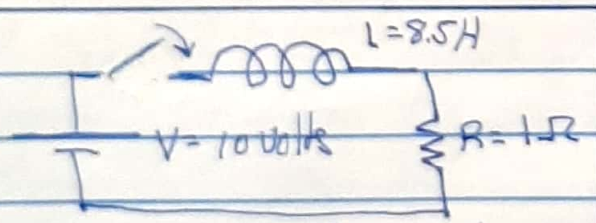


What is the oscillation frequency of this LC series circuit?

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(8.5)(1\times10^{-8})}}$$

$$= \frac{1}{\sqrt{8.5}} \times 10^4 = 343\text{ rad/sec}$$

$$f = 343\,\frac{\text{rad}}{\text{sec}} \times \frac{1\text{ cycle}}{2\pi\text{ rad}} = 546\text{ Hz}$$

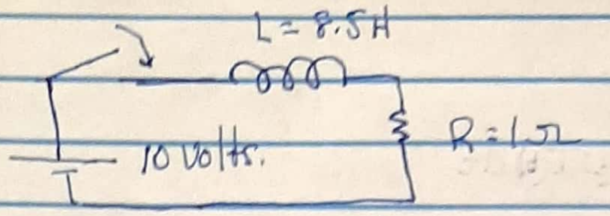


Switch is closed. How much energy will be stored in the inductor when steady state is reached?

$$I_{\text{steady state}} = \frac{V}{R} = \frac{10}{1} = 10\text{ Amps}$$

$$U = \frac{1}{2}LI^2 = \frac{1}{2}(8.5)(10)^2$$

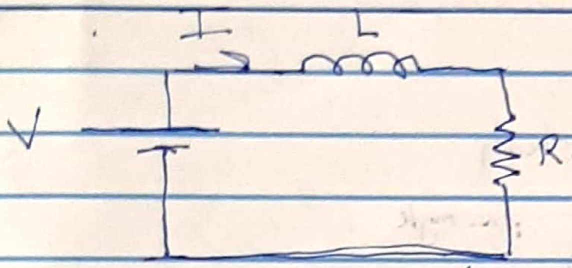
$$= 425\text{ Joules}.$$



after switch is thrown, on what time scale is steady state achieved?

$\tau = L/R = \frac{8.5}{1} = 8.5\ \text{sec} \cong \underline{10\ \text{sec}}$.

$\therefore$ Steady state is obtained on the order of <u>10's of seconds</u>.



write down the modified kirchoff loop rule for this RL circuit. Assuming $I(0)=0$, solve for $I(t)$.

$$V - L\frac{dI}{dt} - IR = 0$$

$$L\frac{dI}{dt} = V - IR$$

$$\int_0^I \frac{dI}{V-IR} = \int_0^t \frac{dt}{L}$$

$$-\frac{1}{R}\ln\left(\frac{V-IR}{V}\right) = \frac{t}{L}$$

$$1 - \frac{IR}{V} = e^{-Rt/L}$$

$$I = \frac{V}{R}\left(1 - e^{-Rt/L}\right)$$

If $V = 10$ volts and $R = 1\Omega$, and $L = 10H$, how long before $I = 5$ Amps in situation above?

$$5\ \text{Amps} = \frac{10\ \text{Volts}}{1\Omega}\left(1 - e^{-\frac{t}{10\,\text{sec}}}\right)$$

set $1 - e^{-t/10} = \frac{1}{2}$

$$e^{-t/10} = 1 - 1/2 = 1/2$$

$$t/10 = \ln(2)$$

$$t = 10\ \text{sec}\ \ln(2) = \underline{6.9\ \text{sec}}$$

How high is typical $\mathcal{E}$ for ac power transmission over long distances?

$\mathcal{E} \cong 345{,}000$ Volts.