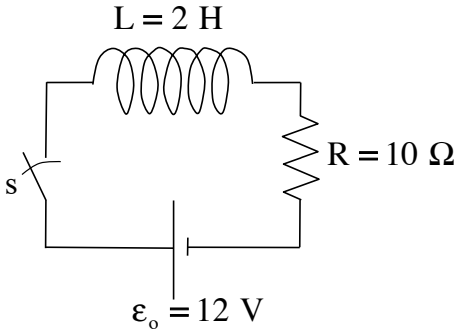
Problem 32.14



The current-function for a RL circuit with a DC source (power supply) is:

$$i(t) = i_o\left(1 - e^{-t/\tau}\right)$$

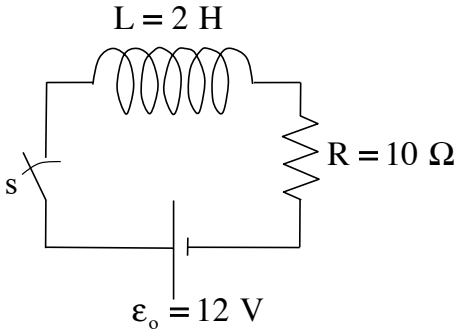
$$\Rightarrow \quad \frac{i(t)}{i_o} = \left(1 - e^{-t/\tau}\right)$$

$$\Rightarrow \quad \ln\left(1 - \frac{i(t)}{i_o}\right) = \ln\left(e^{-t/\tau}\right)$$

$$\Rightarrow \quad \ln\left(1 - \frac{i(t)}{i_o}\right) = -t/\tau$$

$$\Rightarrow \quad t = -\tau\ln\left(1 - \frac{i(t)}{i_o}\right)$$

$$\Rightarrow \quad t = -\left(\frac{L}{R}\right)\ln\left(1 - \frac{i(t)}{i_o}\right)$$



Fitting this to our times, we get:

a.) for 50% of i_o (or $\frac{i(t)}{i_o} = \frac{.5i_o}{i_o} = .5$):

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

$$\Rightarrow \quad t = -\left(\frac{L}{R}\right)\ln(1 - .5)$$

$$= -\left(\frac{2\text{ H}}{10\ \Omega}\right)\ln(1 - .5)$$

$$= .139\ \text{sec}$$

b.) for 90% of i_o:

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

$$\Rightarrow \quad t = -\left(\frac{2\text{ H}}{10\ \Omega}\right)\ln(1 - .9)$$

$$= .461\ \text{sec}$$