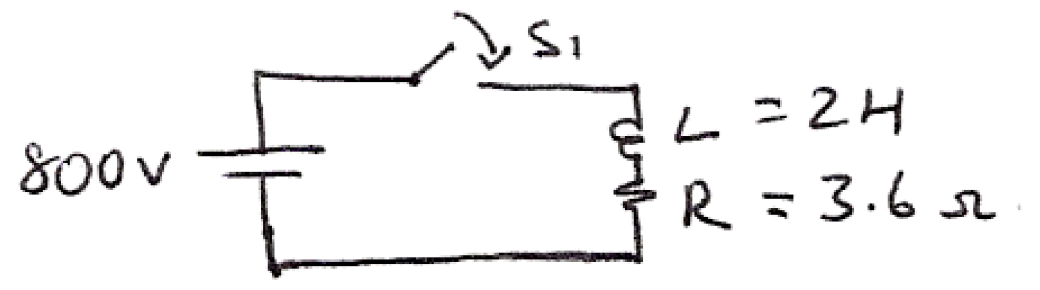
Prob 2.7, Part I



$$\frac{1}{\tau} = \frac{R}{L} = \frac{3.6}{2} = 1.8\,s \qquad I_{max} = \frac{800v}{R} = \frac{800v}{3.6\Omega} = 222\ [A]$$

Charging L: $I(t) = I_{max}\left(1 - e^{-1.8t}\right)$

@ 1s $\quad I(1) = 222\left(1 - e^{-1.8}\right) = 185.3\ [A]$

$$E_L = \frac{1}{2}LI^2 = \frac{1}{2}(2H)(185.3\,A)^2 = 34{,}337\ [J]$$

Total Energy is the integral from t=0 to 1s.

$$E_T = \int_0^1 V I\,dt = \int_0^1 (800)\left(222\left(1-e^{-1.8t}\right)\right)dt$$

$$= 177{,}600 \int_0^1 \left(1-e^{-1.8t}\right)dt = 177{,}600\left[t + \frac{e^{-1.8t}}{1.8}\Big|_0^1\right]$$

$$E_T = 95{,}243\ [J]$$

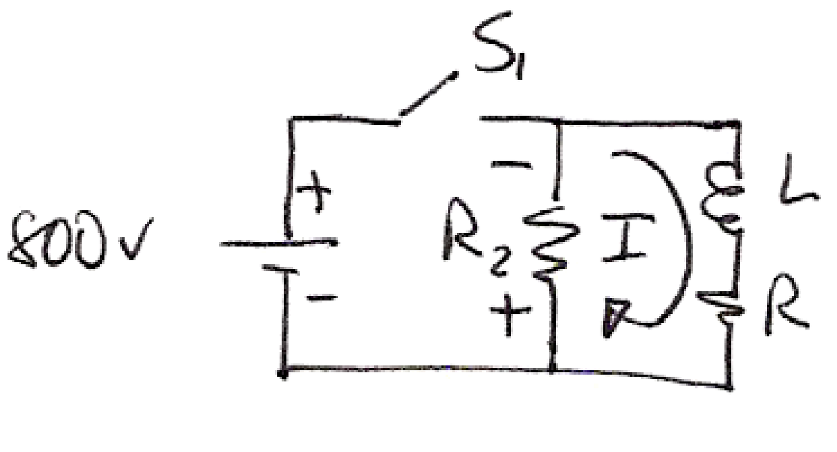
Energy dissipated at the coil is

$$E_{dis} = E_T - E_L = 95{,}243\,[J] - 34337\,[J] = 60{,}905\ [J]$$

Part II

S_1 opens at the same time S_2 closes. In S.S., before S_2 closes,

$I = \frac{800v}{3.6\Omega} = 222\ [A]$ then the switching occurs



$$R_e = R_1 + R_2 = 3.6\Omega + 10\Omega = 13.6\Omega$$

$$\frac{1}{\tau} = \frac{R_e}{L} = \frac{13.6\Omega}{2} = 6.8\,s$$

$I(t) = 222\,e^{-6.8t}$ @ $t = 0.1s$ $\quad I(.1) = 222\,e^{-6.8(.1)}$

$$I(.1) = 112.5\ [A]$$

$$V_{R_2} = (112.5[A])(10\Omega) = 1125\ [V]$$

Voltage at S_1 => $V_{S_1} = 800v + V_{R2} = (800 + 1125)[V]$

$$V_{S_1} = 1925\,[V]$$

All energy stored in L at the time S_2 closes will be dissipated.

$$E_L = \frac{1}{2}LI^2 = \frac{1}{2}(2H)(222A)^2 = 49{,}284\ [J]$$

$$E_{R_2} = \frac{R_2}{R_1+R_2}E_L = \frac{10}{13.6}(49{,}284[J]) = 36{,}238\ [J]$$

The rest will be dissipated in R, coil resistance.