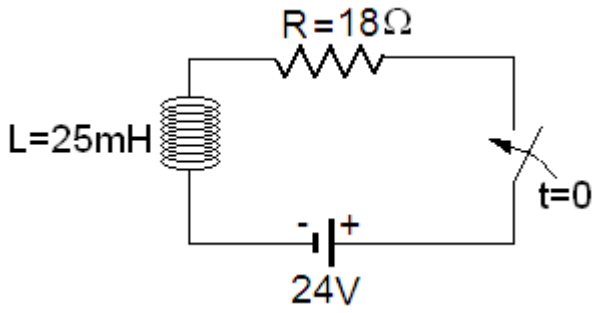
Physics II

RL Circuits

Inductance equation: $V_L = L\dfrac{dI}{dt}$

Rise in current in an LR circuit: $I = I_o\left(1 - e^{-t/\tau}\right)$ where $I_o = \dfrac{V_o}{R}$ and $\tau = \dfrac{L}{R}$

Problem 1.- Find how long after closing the switch the current in the circuit will reach 0.65A



Solution:

$$I = I_o\left(1 - e^{-t/\tau}\right) \rightarrow 0.65A = \frac{24V}{18\Omega}\left(1 - e^{-t/\tau}\right)$$

Where $\tau = \dfrac{L}{R} = \dfrac{25mH}{18\Omega} = 1.389 \text{ ms}$

Solving for t:

$$0.65A = 1.333\left(1 - e^{-t/\tau}\right) \rightarrow 0.4875 = 1 - e^{-t/\tau} \rightarrow e^{-t/\tau} = 1 - 0.4875$$

$$\ln(e^{-t/\tau}) = \ln(0.5125) \rightarrow -t/\tau = \ln(0.5125) \rightarrow t = 0.718\tau = \mathbf{0.99ms}$$