ECE 2210 / 00 Homework 1stTr2 1st - Order Transients

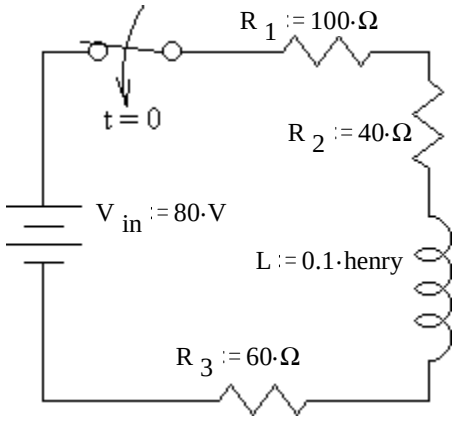
c

Name _____

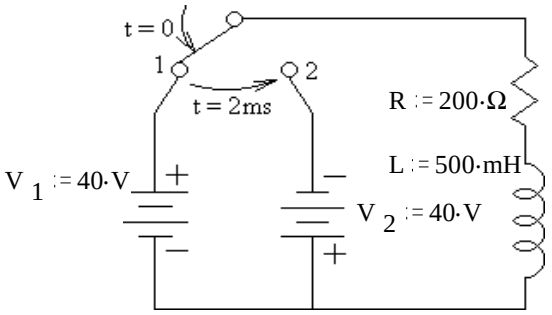
1. A $12\ \mathrm{V}$ car ignition coil has an inductance of $20\ \mathrm{mH}$ and resistance of $1.5\ \Omega$ (so its equivalent circuit is a $20\ \mathrm{mH}$ inductor in series with a $3\ \Omega$ resistor). Calculate how long it takes the current to build up to 95% of its maximum value after a $12\ \mathrm{V}$ battery is connected to the coil.

2. A constant voltage is applied to a series RL circuit by closing a switch. The voltage across L is 40 volts at $t = 0$ and drops to 8 volts at $t = .004\ \mathrm{sec}$. If $\mathrm{L} = 0.1\ \mathrm{H}$, what must be the value of R?

3. In the circuit shown, the switch is closed at $t = 0$. Find the transient current expression.



4. In the circuit shown, the switch is closed on position 1 at t = 0, and then instantly moved to position 2 after 2 milliseconds. Find the time at which the current is zero and reversing its direction.



note the different battery directions

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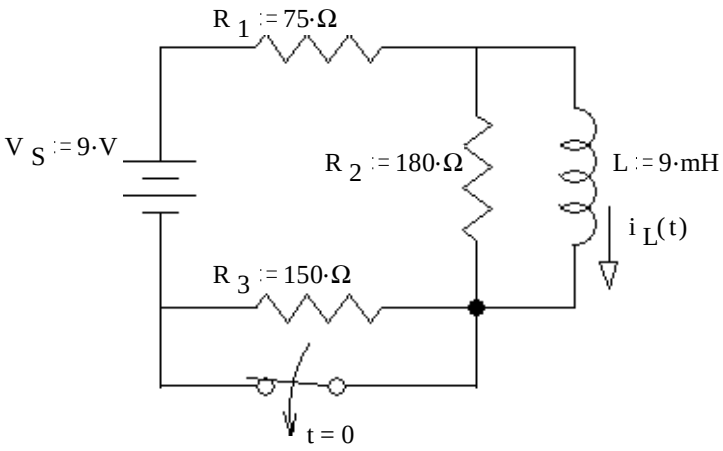
5. The switch has been open (not making contact) for a long time and is switched closed (as shown) at time $t = 0$.
   a) Find the complete expression for $i_L(t)$.



b) Find i_L at time $t = 1.2\tau$. $i_L(1.2\cdot\tau) = ?$ $120\cdot mA - 80\cdot mA\cdot e^{-1.2} = 95.9\cdot mA$

c) At time $t = 1.2\tau$ the switch is opened again. Find the complete expression for $i_L(t')$, where t' starts when the switch opens. Be sure to clearly show the time constant.

Answers

1. $20\cdot ms$ 2. $40.2\cdot\Omega$ 3. $0.4\cdot A\cdot\left(1 - e^{-\frac{t}{0.5\cdot ms}}\right)$ $3.1\cdot ms$ 5. a) $120\cdot mA - 80\cdot mA\cdot e^{-\frac{t}{0.17\cdot ms}}$
   b) $95.9\cdot mA$ c) $40\cdot mA + 56\cdot mA\cdot e^{-\frac{t}{90\cdot\mu s}}$

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