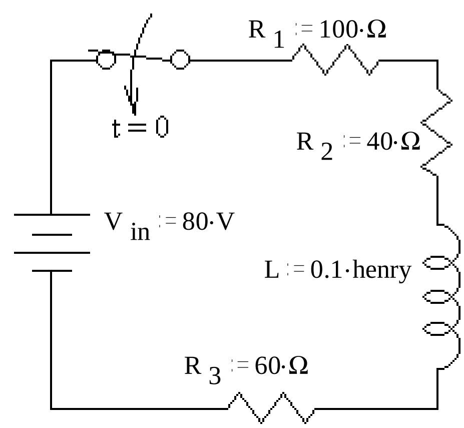
Name ________________________________

1. A 12 V car ignition coil has an inductance of 20 mH and resistance of 1.5 Ω (so its equivalent circuit is a 20 mH inductor in series with a 3 Ω resistor). Calculate how long it takes the current to build up to 95% of its maximum value after a 12 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 $t = .004$ sec. If $L = 0.1$ 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.



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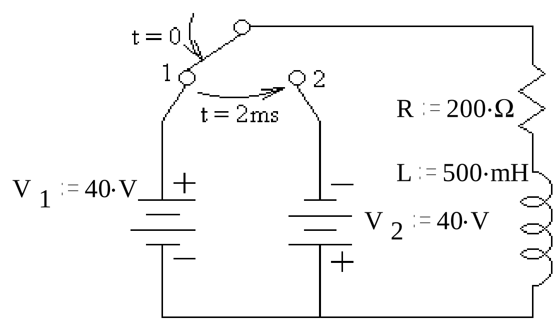
3. continued

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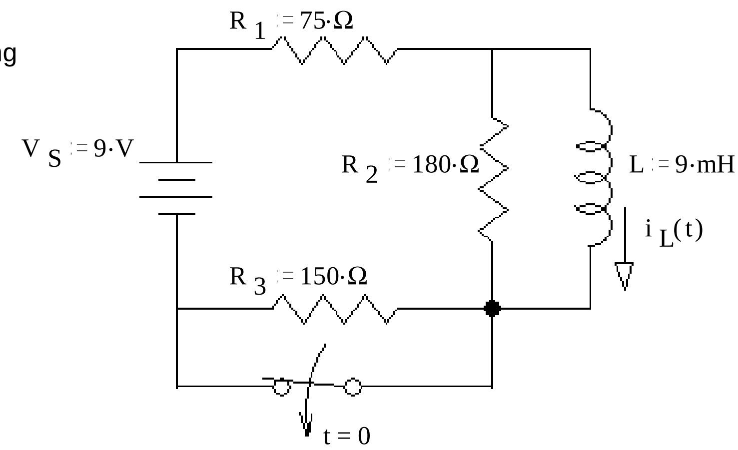
5. The switch has been open (not making contact) for a long time and is switched closed (as shown) at time $t = 0$.
   a) Find the complete expression for $i_L(t)$.



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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