Indian Institute of Technology, Delhi
EEL 101: Fundamentals of Electrical Engineering
Tutorial 5, 11th March, 2008

1. In Fig. (a), the switch is closed at time $t = 0$. Determine the values of $i(0)$, $v(0)$, $di(0)/dt$ and $dv(0)/dt$. Also determine the final values of $i(t)$ and $v(t)$, after an infinitely long time. (Note: V is a constant voltage.)

2. Compute the expression for the characteristic equation for the above circuit.

3. Assume $R = 10k\Omega$, $C = 10pF$, $L = 10nH$. Determine the complete expression for $v(t)$. Is the circuit under-damped or over-damped? What value of R would have made this critically damped?

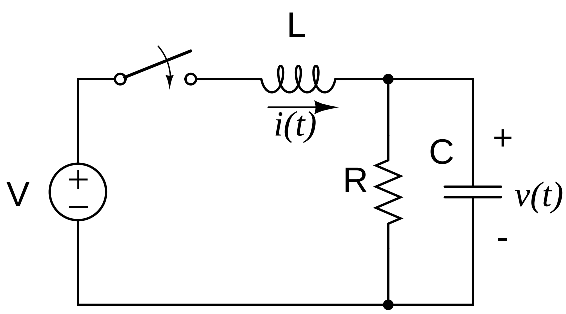
4. After a long time (say, after $T = 10$ seconds), the switch is suddenly thrown open. How will the current through the inductor change? As a result, what will be the potential difference across the switch? (This is what happens when you see "arcing". Arcing is the technical term used for sparks. The inductor tries to hold the current through it, and it creates a huge potential drop across the airgap in the switch, and forces an arc of current across the airgap in the switch. It, in fact, ionizes the air and makes the air a conductor of electricity. So now you know why sometimes you see a spark when you toggle a switch.) Compute the expression for $v(t - T)$.

5. In Fig. (b), the switch is opened at time $t = 0$. What are the values of $v_1(0)$, $v_2(0)$, $i(0)$, $dv_1(0)/dt$, $dv_2(0)/dt$, $di(0)/dt$? Will there be the problem of arcing – as in the previous problem, in this case? Why, or why not? Compute the characteristic equation for the above circuit. Compute the initial conditions for $\frac{d^2v_1(0)}{dt^2}$, $\frac{d^2v_2(0)}{dt^2}$ and $\frac{d^2i(0)}{dt^2}$.

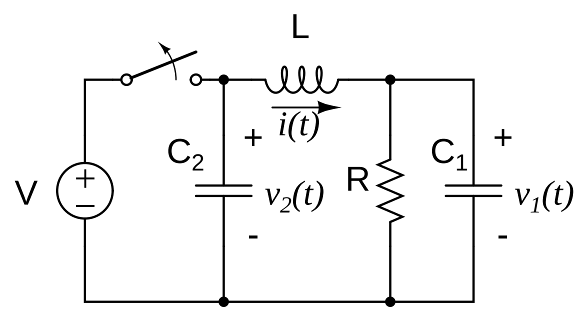
6. In Fig. (c), $R = 5\Omega$, $C = 100\mu F$, and $L = 0.1H$. The switch is closed at time $t = 0$. Compute the values of $v_c(0)$, $i(0)$, $dv_c(0)/dt$, di/dt.

7. Find $v_c(t)$ as a result of only the forced response, if $v(t) = 100\cos(2\pi 60t)$ Volts.

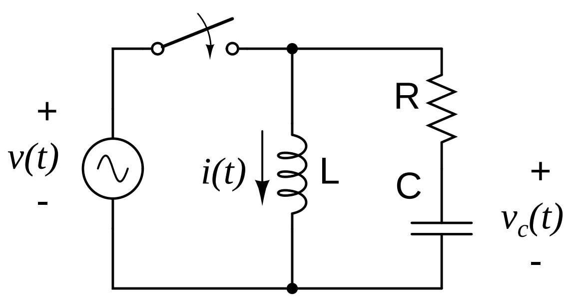
8. Find the characteristic equation for the circuit. Compute the complete function, $v_c(t)$, as a result of both the homogeneous and particular solutions of the differential equation.



(a)



(b)



(c)