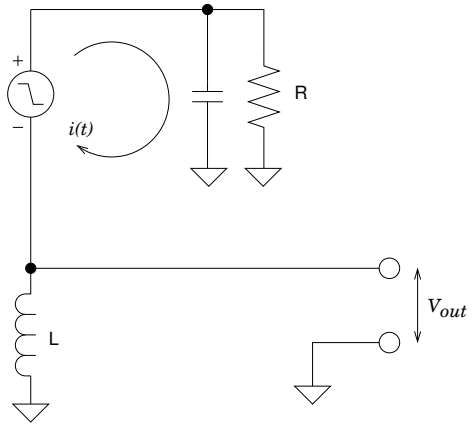
Physics 536 - Assignment #2

1. A voltage source makes a fast transition at $t = 0$ between a positive voltage, V and zero volts, which induces a current of the form $i(t) = (V/R)e^{-t/\tau}$ in the circuit shown below:

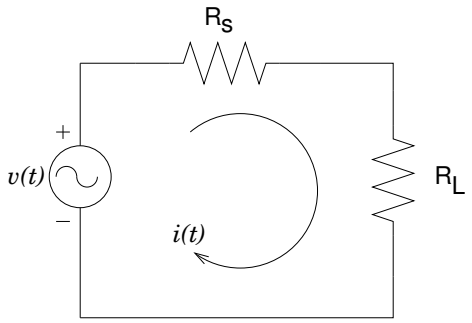


(a) Find an expression for the voltage $v_{out}(t)$.

(b) A fast digital logic circuit could have $V = 5$ V, $R = 50\ \Omega$ and $\tau = 1$ ns. The inductor, L, represents the inductance in the lead that connects the ground on an integrated circuit to the ground on a printed circuit board. Calculate v_{out} at $t = 0$ when $L = 10$ nH.

(c) What is v_{out} at $t = 0$ if the ground lead were connected by means of a long wire to the printed circuit board, resulting in $L = 100$ nH?

2. Consider the circuit below in which a voltage source $v(t) = Ve^{i\omega t}$, with impedance R_s drives a load R_L. What value of R_L will maximize the power transferred to the load? Calculate the maximum power when R_L has this value.



3. Consider the source connected to the load by means of a transformer as shown below. Assuming perfect coupling between the primary and secondary coils, *ie.* $k = 1$ in $M = k\sqrt{L_1 L_2}$, what ratio of L_1/L_2 will maximize the power transferred to a load with impedance R_L at high frequencies. What *turns ratio*, $n = N_1/N_2$, will maximize the power transfered to R_L? How does the maximum power delivered to R_L compare with the maximum power found in question 2?