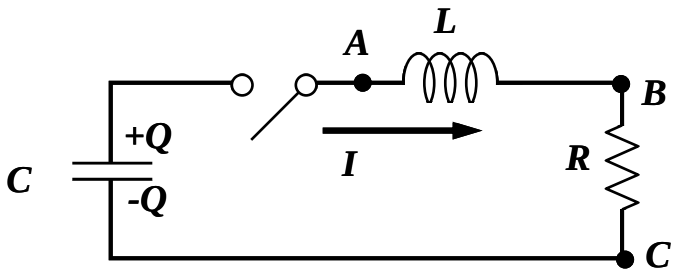
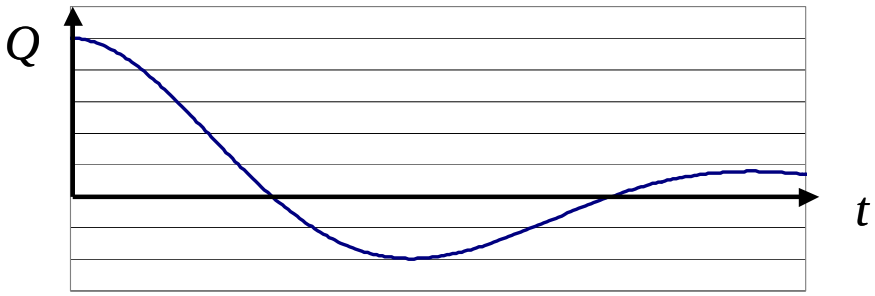
Discussion Question 11A
Physics 212 week 11
RLC Preview

You will learn much more about RLC circuits in the next lecture but here is a preview of their interesting behavior. In this circuit, an initial charge of $Q_0 = 1\mu C$ is placed on the capacitor. At time t=0 the switch is closed.



$Q(t=0) = 1\mu C$
C = 100 nF
L = 500 μH
R = 40 Ω

The charge on the capacitor oscillates while dying out as shown below:



Our conventions are that ***I*** is positive when flowing in the direction of the arrow, and Q is positive when the top plate of the capacitor is positive and the bottom plate is negative as illustrated.

(a) Immediately after the switch is thrown, what is the current ***I*** (0^+)?

(b) Immediately after the switch is thrown, what is the voltage drop across the inductor, and what is the rate of change of current or ***dI/dt*** (0^+) ? Hints: What is the voltage drop across the capacitor? What must the voltage drop across the inductor be according to KVL? How does the voltage drop across an inductor depend on ***dI/dt*** ?

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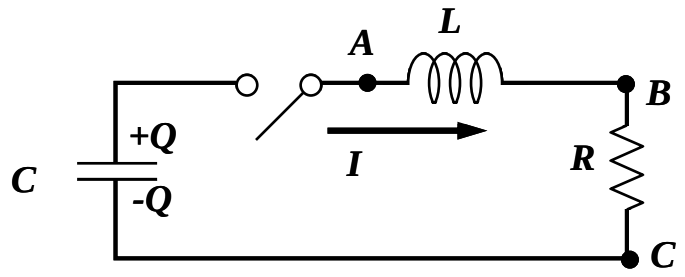

$Q(t=0)=1\mu C$
C = 100 nF
L = 500 μH
R = 40 Ω

(c) At a later time, the charge on the capacitor is Q = + 0.147 μC and $V_B - V_C$ = 3.64 V. Find the rate of change of charge on the capacitor (dQ/dt), the voltage drop across the inductor, and dI/dt . Is the capacitor charge decreasing or increasing at this time? Is the current decreasing or increasing at this time?

(d) At the time discussed in part (c), when the charge on the capacitor is Q = + 0.147 μC and $V_B - V_C$ = 3.64 V. Find the total stored energy and the rate of change of stored energy.

(e) At a still later time, at the instant when there is no voltage drop across the resistor and the charge on the capacitor is Q = –396 nC, find $V_A - V_B$. Is the current I increasing or decreasing?