Physics 142 – Fall 2014 – Workshop module 10

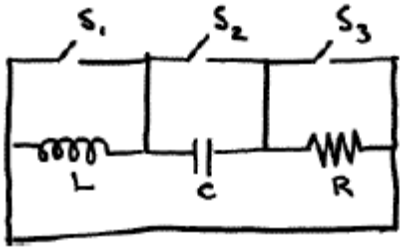
1. A capacitor of area A and plate separation D is fully charged across a potential difference of V and placed in series with and inductor of inductance L, causing LC oscillations to occur. While the LC oscillations are continuing in this resistance-free circuit, the distance between the capacitor plates is increased to 2D.

a) How will the frequency of the LC oscillations in this circuit change when the plate separation is increased to 2D?

b) Relative to the initial situation, while the LC oscillations are continuing, how will the frequency of the LC oscillations in this circuit change if the space between the capacitor's plates are filled with a dielectric with dielectric constant K=4.

2. Consider the circuit below. With switch S_1 closed and the other two switches open, the circuit has time constant τ_1. With switch S_2 closed and the other two switches open, the circuit has time constant τ_2. With switch S_3 closed and the other two switches open, the circuit oscillates with period T. Show that

$$T = 2\pi\sqrt{\tau_1\tau_2}$$



3. If I hook a large capacitor across an ordinary outlet in my house, will it blow a fuse?

4. What is the impedance of a series LCR circuit at resonance?

5. A circuit consists of a resistor connected in series to a battery; the resistance is 5 ohms and the emf of the battery is 12 volts. The wires (of negligible resistance) connecting these circuit elements are laid out along a square of 20 cm x 20 cm. The entire circuit is placed face on in an oscillating magnetic field. The instantaneous value of the magnetic field is $B=B_o\sin\omega t$, with $B_o=0.15$ T and $\omega=360$ radians/s. a) Find the instantaneous current in the resistor. b) Find the average power dissipated in the resistor.