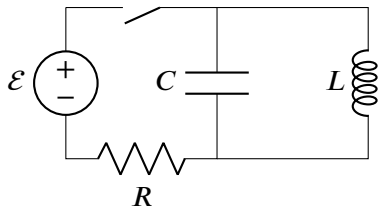
Physics 158 Written Homework 2

Problem 1

Difficulty: ★☆☆
The LRC circuit below is constructed with a 12 V battery, 6 Ω resistor, 5 μF capacitor, and 0.5 mH inductor.



If the switch has been closed for a long time and is suddenly opened, find:

a) How much current is flowing through the inductor just after the switch has been opened.

b) How much charge is stored on the capacitor at the instant the switch is opened.

c) The initial energy in the circuit.

d) The maximum current in the circuit.

e) How often the capacitor attains a max charge per second (only consider the absolute value of the charge).

f) How much power is dissipated in the circuit after 40 seconds.

Problem 2

Difficulty: ★☆☆
A 2 F capacitor, 0.25 H inductor, and a 100 Ω resistor are connected in series with a voltage source $v(t) = 25\cos(80t - \frac{\pi}{2})$

a) What is the impedence of this circuit?

b) What is the peak current?

c) What is the peak voltage across each element?

Problem 3

Difficulty: ★☆☆
A coil with $L = 88\,\text{mH}$ and unknown resistance, and a capacitor ($C = 0.94\,\mu\text{F}$) are connected in series with an alternating EMF operating at a frequency= 930 Hz. If the phase constant between the applied voltage and the current is $+75°$, what is the resistance R of the coil?

Problem 4

Difficulty: ★★☆
Mystery RLC circuit: You are given an RLC circuit with elements connected in series. Values of R, L and C are unknown. You have at your disposal a source of AC voltage with $V_{\text{RMS}} = 8\,\text{V}$ and a tunable frequency ω. You also have an Ammeter which measures the RMS current I_{RMS} and the power factor $\cos\phi$.
Suppose you measured I_{RMS} as a function of frequency and found that the maximum RMS current occurs at $\omega_0 = 12.5\,\text{kHz}$ and is equal to 40 mA.

a) What is the resistance, R? What does this tell you about L and C?

b) What is the power factor at $\omega = \omega_0$?

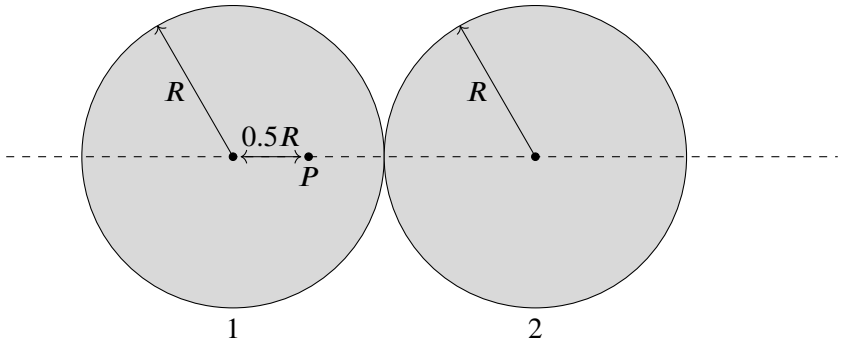
c) In addition you find that at $\omega_1 = 17\,\text{kHz}$ the power factor is 0.5. Based on this information, what are the values of L and C?

Problem 5

Difficulty: ★★☆
An AC circuit is connected in series with a resistor, capacitor, and an inductor with values of $30\,\Omega$, $2\,\mu\text{F}$, and 2 H. If the circuit has an impedence of $Z = 220\,\Omega$ what are all of the possible frequency values, ω?

Problem 6

Difficulty: ★☆☆
Consider two solid spheres of radius R with uniformly distributed charge throughout their volumes. Point P lies on the line connecting the centres of the spheres and is located at a distance of $0.5R$ from the centre of sphere 1 as shown. If the net electric field at P is zero, what is the ratio Q_2/Q_1 of the total charge on each sphere?


R
0.5R
P
R
1
2