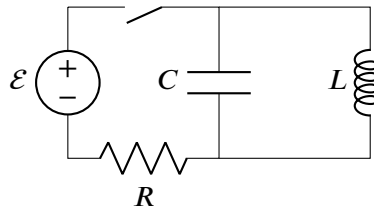


Physics 158 Written Homework 2

Problem 1

Difficulty: ★☆☆

The LRC circuit below is constructed with a 12 V battery, $6\ \Omega$ resistor, $5\ \mu\text{F}$ capacitor, and $0.5\ \text{mH}$ inductor.



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

- How much current is flowing through the inductor just after the switch has been opened.
- How much charge is stored on the capacitor at the instant the switch is opened.
- The initial energy in the circuit.
- The max current in the circuit.
- How often the capacitor attains a max charge per second (only consider the absolute value of the charge).
- How much power is dissipated in the circuit after 40 seconds.

Problem 2

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 $40\ \text{mA}$.

- What is the resistance, R ? What does this tell you about L and C ?
- What is the power factor at $\omega = \omega_0$?
- 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 3

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 $2\ \text{H}$. If the circuit has an impedance of $Z = 220\ \Omega$ what are all of the possible frequency values, ω ?

Problem 4

Difficulty: ★☆☆

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

- a) What is the impedance of this circuit?
- b) What is the peak current?
- c) What is the peak voltage across each element?

Problem 5

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 = $930\ \text{Hz}$. If the phase constant between the applied voltage and the current is $+75^\circ$, what is the resistance R of the coil?

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?

