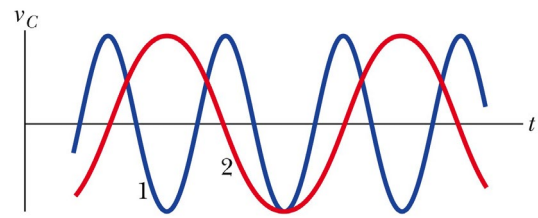
Homework for Chapter 31

(Due 12/7/22)

Questions: 2, 8, 12
Exercises & Problems: 2, 23, 24, 32, 41, 44, 48, 60, 72, 83

Question 2

Figure 31-20 shows graphs of capacitor voltage v_C for LC circuits 1 and 2, which contain identical capacitances and have the same maximum charge Q. Are (a) the inductance L and (b) the maximum current I in circuit 1 greater than, less than, or the same as those in circuit 2?



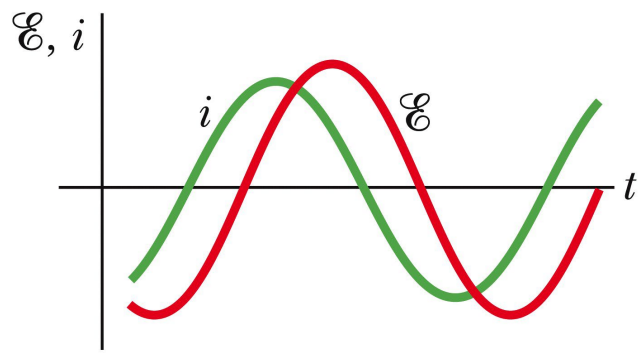
 halliday_9e_fig_31_20

Question 8

The values of the phase constant ϕ for four sinusoidally driven series RLC circuits are (1) -15°, (2) +35°, (3) $\pi/3$ rad, and (4) $-\pi/6$ rad. (a) In which is the load primarily capacitive? (b) In which does the current lag the alternating emf?

Question 12

Figure 31-25 shows the current i and driving emf ε for a series RLC circuit. (a) Does the current lead or lag the emf? (b) Is the circuit's load mainly capacitive or mainly inductive? (c) Is the angular frequency ω_d of the emf greater than or less than the natural angular frequency ω?



 halliday_9e_fig_31_25

Problem 2

The frequency of oscillation of a certain LC circuit is 200 kHz. At time $t = 0$, plate A of the capacitor has maximum positive charge. At what earliest time $t > 0$ will (a) plate A again have maximum positive charge, (b) the other plate of the capacitor have maximum positive charge, and (c) the inductor have maximum magnetic field?

Problem 23

In an oscillating LC circuit, $L = 25.0$ mH and $C = 7.80$ mF. At time $t = 0$ the current is 9.20 mA, the charge on the capacitor is 3.80 μC, and the capacitor is charging. What are (a) the total energy in the circuit, (b) the maximum charge on the capacitor, and (c) the maximum current? (d) If the charge on the capacitor is given by $q = Q\cos(\omega t + \phi)$, what is the phase angle ϕ? (e) Suppose the data are the same, except that the capacitor is discharging at $t = 0$. What then is ϕ?

Problem 24

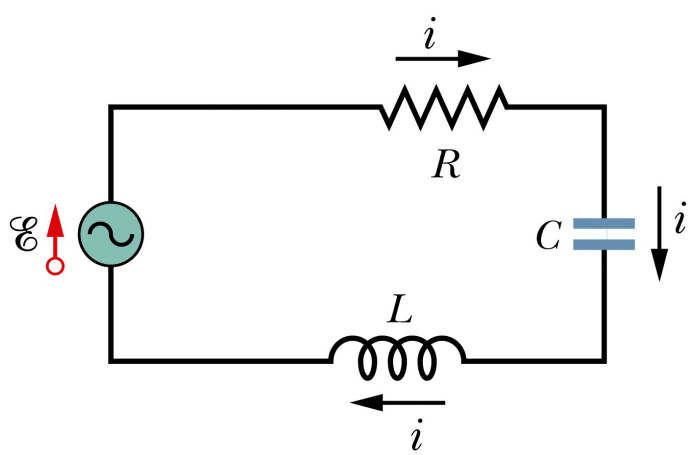
A single-loop circuit consists of a 7.20 Ω resistor, a 12.0 H inductor, and a 3.20 μF capacitor. Initially the capacitor has a charge of 6.20 μC and the current is zero. Calculate the charge on the capacitor N complete cycles later for (a) $N = 5$, (b) $N = 10$, and (c) $N = 100$.

Problem 32

An ac generator has emf $\varepsilon = \varepsilon_m \sin\omega_d t$, with $\varepsilon_m = 25.0$ V and $\omega_d = 377$ rad/s. It is connected to a 12.7 H inductor. (a) What is the maximum value of the current? (b) When the current is a maximum, what is the emf of the generator? (c) When the emf of the generator is -12.5 V and increasing in magnitude, what is the current?

Problem 41

In Fig. 31-7, set $R = 200\ \Omega$, $C = 70.0\ \mu$F, $L = 230$ mH, $f_d = 60.0$ Hz, and $\varepsilon_m = 36.0$ V. What are (a) Z, (b) ϕ, and (c) I? (d) Draw a phasor diagram.



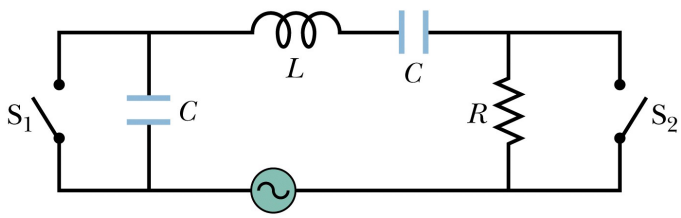
 halliday_9e_fig_31_07

Problem 44

An ac generator with $\varepsilon_m = 220$ V and operating at 400 Hz causes oscillations in a series RLC circuit having $R = 220\ \Omega$, $L = 150$ mH, and $C = 24.0\ \mu$F. Find (a) the capacitive reactance X_C, (b) the impedance Z, and (c) the current amplitude I. A second capacitor of the same capacitance is then connected in series with the other components. Determine whether the values of (d) X_C, (e) Z, and (f) I increase, decrease, or remain the same.

Problem 48

Figure 31-31 shows a driven *RLC* circuit that contains two identical capacitors and two switches. The emf amplitude is set at 12.0 V, and the driving frequency is set at 60.0 Hz. With both switches open, the current leads the emf by 30.9°. With switch S_1 closed and switch S_2 still open, the emf leads the current by 15.0°. With both switches closed, the current amplitude is 447 mA. What are (a) R, (b) C, and (c) L?



 halliday_9e_fig_31_31

Problem 60

In a series oscillating *RLC* circuit, $R = 16.0\ \Omega$, $C = 31.2\ \mu F$, $L = 9.20$ mH, and $\varepsilon = \varepsilon_m \sin \omega_d t$ with $\varepsilon_m = 45.0$ V and $\omega_d = 3000$ rad/s. For time $t = 0.442$ ms find (a) the rate P_g at which energy is being supplied by the generator, (b) the rate P_C at which the energy in the capacitor is changing, (c) the rate P_L at which the energy in the inductor is changing, and (d) the rate P_R at which energy is being dissipated in the resistor. (e) Is the sum of P_C, P_L, and P_R greater than, less than, or equal to P_g?

Problem 72

A series *RLC* circuit is driven in such a way that the maximum voltage across the inductor is 1.50 times the maximum voltage across the capacitor and 2.00 times the maximum voltage across the resistor. (a) What is ϕ for the circuit? (b) Is the circuit inductive, capacitive, or in resonance? The resistance is 49.9 Ω, and the current amplitude is 200 mA. (c) What is the amplitude of the driving emf?

Problem 83

A generator with an adjustable frequency of oscillation is wired in series to an inductor of L = 2.50 mH and a capacitor of $C = 3.00\ \mu F$. At what frequency does the generator produce the largest possible current amplitude in the circuit?