Problems on AC circuits

Section 33.2 Resistors in an AC Circuit

1. The rms output voltage of an AC source is 200 V and the operating frequency is 100 Hz. Write the equation giving the output voltage as a function of time.

2. (a) What is the resistance of a lightbulb that uses an average power of 75.0 W when connected to a 60.0-Hz power source having a maximum voltage of 170 V? (b) What If? What is the resistance of a 100-W bulb?

4. In the simple AC circuit shown in Figure 33.2, R = 70.0 Ω and $\Delta v = \Delta V_{max} \sin \omega t$. If $\Delta v_R = 0.250\ \Delta V_{max}$ for the first time at t = 0.010 0 s, what is the angular frequency of the source?

Section 33.3 Inductors in an AC Circuit

8. An inductor is connected to a 20.0-Hz power supply that produces a 50.0-V rms voltage. What inductance is needed to keep the instantaneous current in the circuit below 80.0 mA?

9. In a purely inductive AC circuit, as shown in Figure 33.6, ΔV_{max} = 100 V. (a) The maximum current is 7.50 A at 50.0 Hz. Calculate the inductance L. (b) What If? At what angular frequency ω is the maximum current 2.50 A?

10. An inductor has a 54.0-Ω reactance at 60.0 Hz. What is the maximum current if this inductor is connected to a 50.0-Hz source that produces a 100-V rms voltage?

11. For the circuit shown in Figure 33.6, ΔV_{max} = 80.0 V, $\omega = 65.0\pi$ rad/s, and L = 70.0 mH. Calculate the current in the inductor at t = 15.5 ms.

12. A 20.0-mH inductor is connected to a standard electrical outlet (ΔV_{rms} = 120 V; f = 60.0 Hz). Determine the energy stored in the inductor at t = (1/180) s, assuming that this energy is zero at t = 0.

Section 33.4 Capacitors in an AC Circuit

14. (a) For what frequencies does a 22.0-μF capacitor have a reactance below 175 Ω? (b) What If? Over this same frequency range, what is the reactance of a 44.0-μF capacitor?

15. What is the maximum current in a 2.20-μF capacitor when it is connected across (a) a North American electrical outlet having ΔV_{rms} = 120 V, f = 60.0 Hz, and (b) What If? a European electrical outlet having ΔV_{rms} = 240 V, f = 50.0 Hz?

16. A capacitor C is connected to a power supply that operates at a frequency f and produces an rms voltage ΔV. What is the maximum charge that appears on either of the capacitor plates?

17. What maximum current is delivered by an AC source with ΔV_{max} = 48.0 V and f = 90.0 Hz when connected across a 3.70-μF capacitor?

18. A 1.00-mF capacitor is connected to a standard electrical outlet (ΔV_{rms} = 120 V; f = 60.0 Hz). Determine the current in the capacitor at t = (1/180) s, assuming that at t = 0, the energy stored in the capacitor is

Section 33.5 The RLC Series Circuit

An inductor (L = 400 mH), a capacitor (C = 4.43 μF), and a resistor (R = 500 Ω) are connected in series. A 50.0-Hz AC source produces a peak current of 250 mA in the circuit. (a) Calculate the required peak voltage ΔV_{max}. (b) Determine the phase angle by which the current leads or lags the applied voltage.

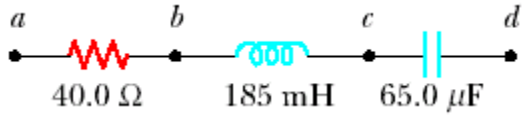
20. At what frequency does the inductive reactance of a 57.0-μH inductor equal the capacitive reactance of a 57.0-μF capacitor?

21. A series AC circuit contains the following components: R = 150 Ω, L = 250 mH, C = 2.00 μF and a source with ΔV_{max} = 210 V operating at 50.0 Hz. Calculate the (a) inductive reactance, (b) capacitive reactance, (c) impedance, (d) maximum current, and (e) phase angle between current and source voltage.

22. A sinusoidal voltage $\Delta v(t) = (40.0\ V) \sin(100t)$ is applied to a series RLC circuit with L = 160 mH, C = 99.0 μF, and R = 68.0 Ω. (a) What is the impedance of the circuit? (b) What is the maximum current? (c) Determine the numerical values for I_{max}, ω, and φ in the equation $i(t) = I_{max} \sin(\omega t - \varphi)$.

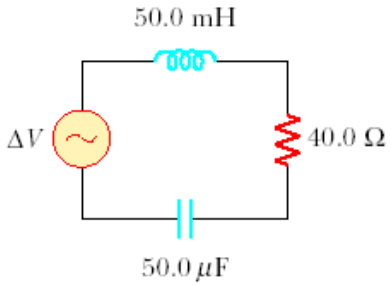
23. An RLC circuit consists of a 150-Ω resistor, a 21.0-μF capacitor, and a 460-mH inductor, connected in series with a 120-V, 60.0-Hz power supply. (a) What is the phase angle between the current and the applied voltage? (b) Which reaches its maximum earlier, the current or the voltage?

26. An AC source with ΔV_{max} = 150 V and f = 50.0 Hz is connected between points a and d in Figure P33.26. Calculate the maximum voltages between points (a) a and b, (b) b and c, (c) c and d, and (d) b and d.



Section 33.6 Power in an AC Circuit

30. The voltage source in Figure P33.30 has an output of ΔV_{rms} = 100 V at ω = 1 000 rad/s. Determine (a) the current in the circuit and (b) the power supplied by the source. (c) Show that the power delivered to the resistor is equal to the power supplied by the source.



31. An AC voltage of the form Δv = (100 V) sin(1 000t) is applied to a series *RLC* circuit. Assume the resistance is 400 **Ω**, the capacitance is 5.00 μF, and the inductance is 0.500 H. Find the average power delivered to the circuit.

32. A series *RLC* circuit has a resistance of 45.0 **Ω** and an impedance of 75.0 **Ω**. What average power is delivered to this circuit when ΔV_{rms} = 210 V?

33. In a certain series *RLC* circuit, I_{rms} = 9.00 A, ΔV_{rms} = 180 V, and the current leads the voltage by 37.0°. (a) What is the total resistance of the circuit? (b) Calculate the reactance of the circuit ($X_L - X_C$).