(II) A 2.44-m-long coil containing 300 loops is wound on an iron core (average $\mu = 2000\mu_0$) along with a second coil of 100 loops. The loops of each coil have a radius of 2.00-cm. If the current in the first coil drops uniformly from 12.0 A to zero in 98.0 ms, determine: (*a*) the mutual inductance M; (*b*) the emf induced in the second coil.

(II) Determine the mutual inductance per unit length between two long solenoids, one inside the other, whose radii are r_1 and $r_2 (r_2 < r_1)$ and whose turns per unit length are n_1 and n_2.

Compare the oscillations of an LRC circuit to the vibration of a mass m on a spring. What do L and C correspond to in the mechanical system?

(I) Estimate the inductance L of a 0.45-m-long air-filled coil 3.7 cm in diameter containing 20,000 loops.

(I) What is the inductance of a coil if it produces an emf of 8.50 V when the current in it changes uniformly from −22.0 mA to +23.0 mA in 21.0 ms?

Under what conditions is the impedance in an LRC circuit a minimum?

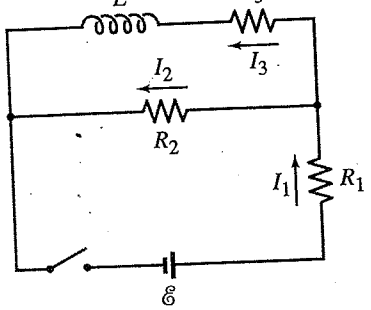
(I) How much energy is stored in a 400-mH inductor at an instant when the current is 9.0 A?

(II) It takes 2.56 ms for the current in an LR circuit to increase from zero to half its maximum value. Determine (*a*) the time constant of the circuit, (*b*) the resistance of the circuit if $L = 310$ H.

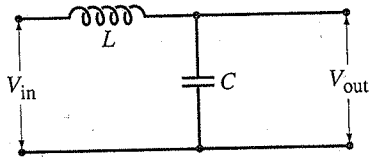
(I) A 1.20-kΩ resistor and a 6.8-μF capacitor are connected in series to an ac source. Calculate the impedance of the circuit if the source frequency is (*a*) 60 Hz; (*b*) 60,000 Hz.

(I) A 9.0-kΩ resistor is in series with a 26.0-mH inductor and an ac source. Calculate the impedance of the circuit if the source frequency is (*a*) 50 Hz; (*b*) 30,000 Hz.

(II) In the circuit of Fig. 30–16, determine the current in each resistor (I_1, I_2, I_3) at the moment (*a*) the switch is closed, (*b*) a long time after the switch is closed. After the switch has been closed a long time, and reopened, what is each current (*c*) just after it is opened, (*d*) after a long time?



Filter circuit. The figure shows a simple filter circuit designed to pass dc voltages with minimal attenuation and to remove, as much as possible, any ac components (such as 60-Hz line voltage that could cause hum in a stereo receiver, for example). Assume $V_{in} = V_1 + V_2$ where V_1 is dc and $V_2 = V_{20} \sin \omega t$, and that any resistance is very small. (*a*) Determine the current through the capacitor: give amplitude and phase (assume $R = 0$ and $X_L > X_C$). (*b*) Show that the ac component of the output voltage, $V_{2\,out}$, equals Q/C where Q is the charge on the capacitor at any instant, and determine the amplitude and phase of $V_{2\,out}$. (*c*) Show that the attenuation of the ac voltage is greatest when $X_C \ll X_L$, and calculate the ratio of the output to input ac voltage in this case. (*d*) Compare the dc output to input voltage.



A pair of straight parallel thin wires, such as a lamp cord, each of radius r, are a distance l apart and carry current to a circuit some distance away. Ignoring the field within each wire, show that the inductance per unit length is $(\mu_0/\pi) \ln[(l - r)/r]$.