Chapter-31

1. You are working as an electrical technician. One day, out in the field, you need an inductor but cannot find one. Looking in your wire supply cabinet, you find a cardboard tube with single-conductor wire wrapped uniformly around it to form a solenoid. You carefully count the turns of wire and find that there are 580 turns. The diameter of the tube is 8.00 cm, and the length of the wire-wrapped portion is 36.0 cm. You pull out your calculator to determine (a) the inductance of the coil and (b) the emf generated in it if the current in the wire increases at the rate of 4.00 A/s.

**Conceptualize** You may have seen wire wrapped uniformly around cardboard tubes at a home store or hardware store. They represent ready-made inductors!

**Categorize** We can find the results using equations in Section 31.1, so we will categorize the problem as a substitution problem.

(a) Use Equation 31.4 to find the inductance:



(b) Use Equation 31.1 to find the emf:



1. A 24.0-V battery is connected in series with a resistor and an inductor, with *R* = 8.00 Ω and *L* = 4.00 H, respectively. Find the energy stored in the inductor (a) when the current reaches its maximum value and (b) at an instant that is a time interval of one time constant after the switch is closed.

 The current in the circuit at time t is  where  and the energy stored in the inductor is

 (a) As 

 

 (b) At 

 

1. Two solenoids A and B, spaced close to each other and sharing the same cylindrical axis, have 400 and 700 turns, respectively. A current of 3.50 A in solenoid A produces an average flux of 300 *m*Wb through each turn of A and a flux of 90.0 *µ*Wb through each turn of B. (a) Calculate the mutual inductance of the two solenoids. (b) What is the inductance of A? (c) What emf is induced in B when the current in A change at the rate of 0.500 A/s?

 (a) The mutual inductance of the coils is



 (b) The inductance of coil A is

 

 (c) The emf induced in the other coil is

 

1. Electrical oscillations are initiated in a series circuit containing a capacitance *C*, inductance *L*, and resistance *R.* (a) If *R* << $\sqrt{4L∕C}$(weak damping), what time interval elapses before the amplitude of the current oscillation falls to 50.0% of its initial value? (b) Over what time interval does the energy decrease to 50.0% of its initial value?

 At t = 0 the capacitor charge is at its maximum value, so  = 0 in

 

 Substituting the given information, the charge at 2 ms is

 

 (a) Then the energy in the capacitor is

 

 (c) The constant total energy is that originally of the capacitor:

 