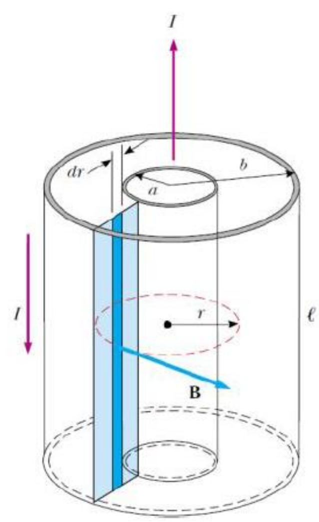
106 PHYS – Homework 4

Chapter 4 Inductance

Chapter 32 in the text book

1. A coil has an inductance of 3.00 mH, and the current in it changes from 0.200 A to 1.50 A in a time of 0.200 s. Find the magnitude of the average induced emf in the coil during this time.

2. Cables are often used to connect electrical devices, such as your stereo system, and in receiving signals in TV cable systems. Model a long cable as consisting of two thin cylindrical conducting shells of radii *a* and *b* and length l, as in Figure. The conducting shells carry the same current *I* in opposite directions. Imagine that the inner conductor carries current to a device and that the outer one acts as a return path carrying the current back to the source.
   (A) Calculate the self-inductance *L* of this cable.
   (B) Calculate the total energy stored in the magnetic field of the cable.



3. A 10.0-mH inductor carries a current $I=I_{max}\sin\omega t$, with $I_{max}=5.00$ A and $\omega/2\pi=60.0$ Hz. What is the back emf as a function of time?

4. An emf of 24.0 mV is induced in a 500-turn coil at an instant when the current is 4.00 A and is changing at the rate of 10.0 A/s. What is the magnetic flux through each turn of the coil?

5. An air-core solenoid with 68 turns is 8.00 cm long and has a diameter of 1.20 cm. How much energy is stored in its magnetic field when it carries a current of 0.770 A?

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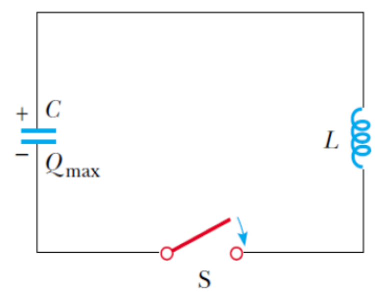
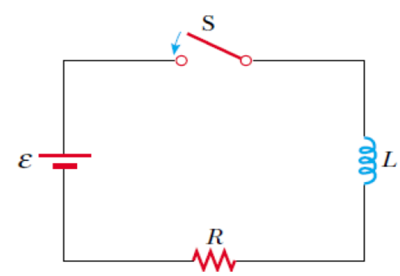
6. Two coils are close to each other. The first coil carries a time varying current given by $I(t)=(5.00\ A)\ e^{-0.025\,t}\sin(377t)$. At t =0.800 s, the emf measured across the second coil is -3.20 V. What is the mutual inductance of the coils?

7. An *LC* circuit like the one in Figure contains an82.0-mH inductor and a 17.0-µF capacitor that initially carries a 180µC charge. The switch is open for $t < 0$ and then closed at $t = 0$.
(a) Find the frequency (in hertz) of the resulting oscillations.
(b) At t = 1.00 ms, find the charge on the capacitor and
(c) At t = 1.00 ms, find the current in the circuit.



8. Consider an *LC* circuit in which L = 500 mH and C = 0.100 µF. (a) What is the resonance frequency ω_0? (b) If a resistance of 1. kΩ is introduced into this circuit, what is the frequency of the (damped) oscillations? (c) What is the percent difference between the two frequencies?

9. Consider the circuit in Figure, taking ε = 6.00 V, L =8.00 mH, and R =4.00 Ω (a) What is the inductive time constant of the circuit? (b) Calculate the current in the circuit 250 's after the switch is closed. (c) What is the value of the final steady-state current? (d) How long does it take the current to reach 80.0% of its maximum value?



10. In Figure 32.21, let R =7.60 Ω, L=2.20 mH, and C=1.80 µF.
(a) Calculate the frequency of the damped oscillation of the circuit.
(b) What is the critical resistance?