Home Work 10

10-1 Figure A shows two parallel loops of wire having a common axis. The smaller loop (radius r) is above the larger loop (radius R) by a distance x>>R. Consequently, the magnetic field due to the counterclockwise current *i* in the larger loop is nearly uniform throughout the smaller loop. Suppose that x is increasing at the constant rate dx/dt = *v*. (a) Find an expression for the magnetic flux through the area of the smaller loop as a function of x. (Hint: See Eq. 29-27.) In the smaller loop, find (b) an expression for the induced emf and (c) the direction of the induced current.

10-2 Figure B shows a copper strip of width W = 16.0 cm that has been bent to form a shape that consists of a tube of radius R = 1.8 cm plus two parallel flat extensions. Current *i* = 35 mA is distributed uniformly across the width so that the tube is effectively a one-turn solenoid. Assume that the magnetic field outside the tube is negligible and the field inside the tube is uniform. What are (a) the magnetic field magnitude inside the tube and (b) the inductance of the tube (excluding the flat extensions)?

10-3 A coil C of N turns is placed around a long solenoid S of radius R and n turns per unit length, as in Figure C. (a) Show that the mutual inductance for the coil–solenoid combination is given by $M = \mu_0 \pi R^2 nN$. (b) Explain why M does not depend on the shape, size, or possible lack of close packing of the coil.

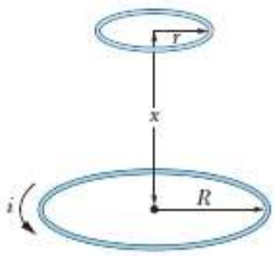

Fig. A

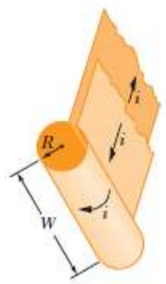

Fig. B

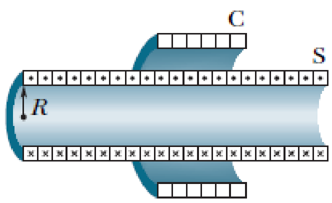

Fig. C

10-4 *Inductors in series*. Two inductors L_1 and L_2 are connected in series and are separated by a large distance so that the magnetic field of one cannot affect the other. (a) Show that the equivalent inductance is given by $L_{eq} = L_1 + L_2$.

(*Hint:* Review the derivations for resistors in series and capacitors in series. Which is similar here?) (b) What is the generalization of (a) for *N* inductors in series?

10-5 *Inductors in parallel*. Two inductors L_1 and L_2 are connected in parallel and separated by a large distance so that the magnetic field of one cannot affect the other. (a) Show that the equivalent inductance is given by $\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2}$.

(*Hint:* Review the derivations for resistors in parallel and capacitors in parallel. Which is similar here?) (b) What is the generalization of (a) for *N* inductors in parallel?