Physics 142 – Fall 2008 – Workshop module 9

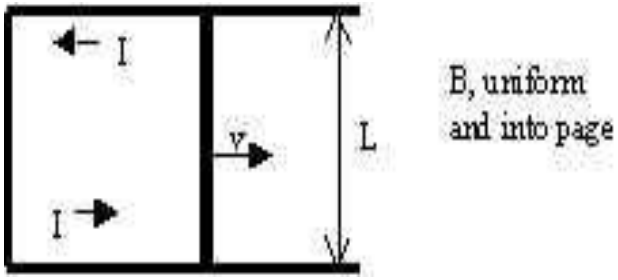
1. Quickly review the concept of electromagnetic induction. Break up into 3 groups if possible. Create two problems for the rest of the class to figure out … be tricky! Each group should go to the board and present their problems for the class to discuss.

   Group 1 should consider two circular loops lying next to each other in a plane. Current of either charge flows with a time-dependence in either direction in one of the loops. What is the direction of the induced current in the other loop?

   Group 2 should do the same … except the two loops in this case are not in the same plane, rather they are coaxial with one lying near the other … like two rings on one finger.

   Group 3 should consider a long, straight current carrying wire with a time–dependent current of either charge going in either direction. Near, but not encircling, this wire they should place a circular conducting loop … in ANY orientation. What is the direction of the induced current in the loop?

2. In the figure below, a rod with length L=0.0650 m moves in a magnetic field with a magnitude B=1.20 T. The emf induced in the moving rod is 0.320 V. a) What is the speed of the rod? b) If the total circuit resistance is 0.800 Ohms, what is the induced current? c) What force (magnitude and direction) does the field exert on the rod as a result of this current? Can you think of different ways to explain the existence of this force?



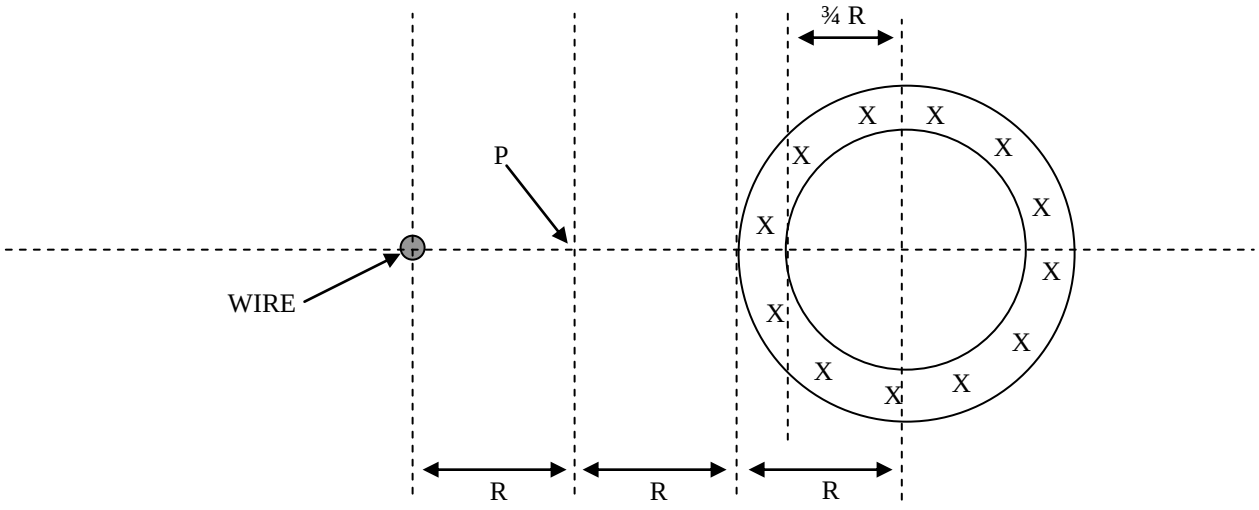
3. Two closely wound circular coils have the same number of turns, but one has twice the radius of the other. How are the self-inductances of the two coils related?

4. Two coils are wound on the same form so that the magnetic field from one coil produces flux through the turns of the second coil. When the current in the first coil is decreasing at a rate of -0.0850 A/s, the induced emf in the second coil has magnitude 7.3×10^{-3} V. a) What is the mutual inductance of the pair of coils? B) If the second coil has five turns, what is the flux through each turn when the current in the first coil equals 1.60 A? c) If the current in the second coil increases at a rate of 0.0500 A/s, what is the induced emf in the first coil?

5. A wire lies parallel to a conducting pipe of radius R and thickness ¼ R. The wire lies at a distance of 3R from the center of the pipe. The wire and pipe are configured perpendicular to the paper, as shown below in a sketch. The pipe carries a uniform current of magnitude I directed into the paper. The current is in the region shown. That is to say, the interior of the pipe (r<3/4/R) is empty and carries no current.

(a) Determine the magnitude and direction of current in the wire which will cause the magnetic field at point P to be zero.

(b) Given your answer to part (a), what is the magnitude and direction of the magnetic field at the center of the current-carrying pipe.



6. Determine the potential difference between points X and Y in the circuit below.