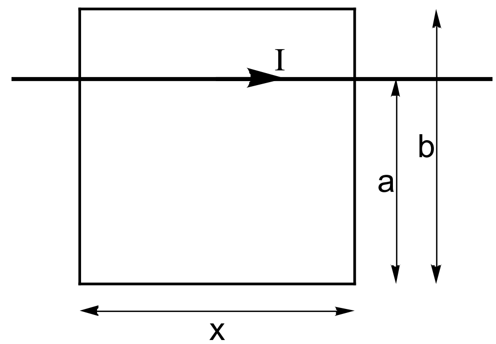
PH 203H/213H
S09 Homework – due Monday, May 4, 2009

1. The square loop of wire of side $b = 0.16$ m lies on a long straight wire with $a = 0.12$ m on one side of the wire and $b - a = 0.04$ m on the other side. The current in the long wire is $I = 4.50t^2 - 10.0t$, where I is in amperes and t is in seconds. (a) What is the total flux through the loop at any time t? [Hint: Divide the loop into narrow strips of width dr parallel to the long wire and a distance r from the wire, find the flux through each narrow strip, and integrate over the loop to get the total flux. Be sure to take the field direction into account.] (b) Find the emf in the square loop at $t = 3.0$ s. (c) What is the direction of the induced current in the loop?



Answers: (a) $\Phi_B = \frac{\mu_0 I b}{2\pi} \ln\left(\frac{a}{b-a}\right)$ (b) 5.98×10^{-7} V

2. A rectangular loop 50.0 cm by 20.0 cm consists of 100 turns of wire. It is placed entirely in a uniform magnetic field of 3.50 T. What is the maximum emf produced when the loop is spun at 1000 rev/min about an axis that is perpendicular to the direction of the magnetic field?
Answer: 5500 V

3. In the circuit shown, $E = 10.0$ V, $R_1 = 5.0\ \Omega$, $R_2 = 10.0\ \Omega$, and $L = 5.0$ H. (a) Just after the switch is closed, what are the values of the current I_1 through R_1, the current I_2 through R_2, the current I through the switch, the potential difference across R_2, the potential difference across L, and the rate of change of I_2? (b) A long time after the switch is closed, what are the values of the current I_1 through R_1, the current I_2 through R_2, the current I through the switch, the potential difference across R_2, the potential difference across L, and the rate of change of I_2?