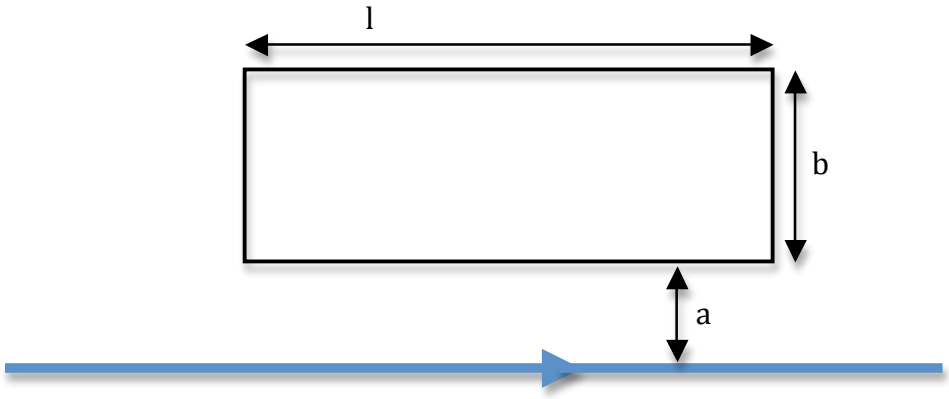
Quiz on Motional EMF

Name _____



1982E2. As shown above a rectangular loop is located next to a long straight wire carrying a current $i = i_m \sin\omega t$

The wire and the loop are in the plane of the page and fixed in space

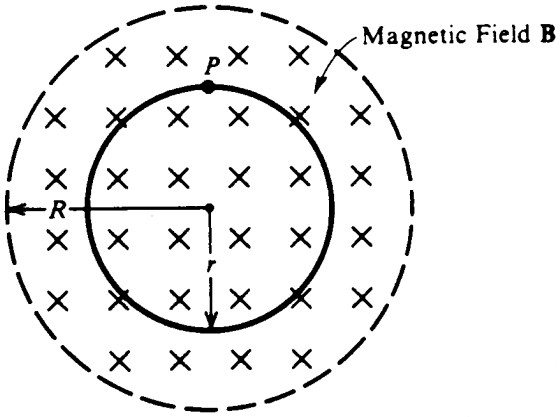
a. Using Ampere's law, show that the magnetic c field intensity at a distance r from the wire is $B = \mu_o I/2\pi r$, with μ_o being the permeability of free space.

b. Find the magnetic flux Φ_B through the loop at time t.

c. The current i in the long wire is in the direction shown above from t = 0 to $t = \pi/\omega$.

   i. indicate on the diagram above the direction of the resulting current that is induced in the loop at time $t = \pi/\omega$

   ii. Determine the emf that is induced in the loop at time $t = \pi/\omega$.



2. 1985E3. A spatially uniform magnetic field B. perpendicular to the plane of the page, exists in a circular region of radius R = 0.75 meter as shown above. A single wire loop of radius r = 0.5 meter is placed concentrically in the magnetic field and in the plane of the page. The magnetic field increases into the page at a constant rate of 60 teslas per second.

a. Determine the induced emf in the loop.

b. Determine the magnitude and direction of the induced electric field at point P and indicate its direction on the diagram above.

The wire loop is replaced by an evacuated doughnut-shaped glass tube, within which a single electron orbits at a constant radius r = 0.5 meter when the spatially uniform magnetic field is constant at 10^{-4} tesla.

c. Determine the speed of the electron in this orbit.

d. The magnetic field is now made to increase at a constant rate of 60 teslas per second as in parts (a) and (b) above. Determine the tangential acceleration of the electron at the instant the field begins to increase.