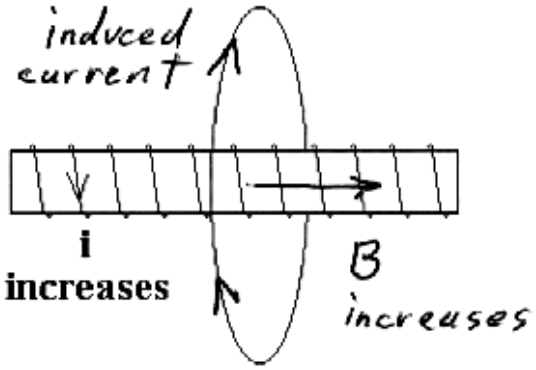
Name: KEY

PHYSICS 2220 - QUIZ #7 - SPRING 2009

1. A long solenoid with a radius of 35 mm has 250 turns/cm. A single loop of wire of radius 5 cm is placed around the solenoid, the central axes of the loop and the solenoid coinciding. In 15 μs the current in the solenoid is increased from 2.5 A to 3.0 A at a uniform rate.



a. What is the magnitude of the initial magnetic field in the solenoid?

$$B_i = \mu_0 \left(\frac{N}{\ell}\right) i = \left(4\pi \times 10^{-7} \frac{T \cdot m}{A}\right)\left(250 \frac{1}{cm}\right)\left(\frac{100\ cm}{1\ m}\right)(2.5A)$$

$$= \boxed{7.85 \times 10^{-2}\ T}$$

$$\text{Also, } B_f = \left(4\pi \times 10^{-7} \frac{T \cdot m}{A}\right)\left(250 \frac{1}{cm}\right)\left(\frac{100\ cm}{1\ m}\right)(3.0A)$$

$$= 9.42 \times 10^{-2}\ T$$

b. What emf appears in the loop? Draw the direction of the induced current in the loop.

$$\mathcal{E} = -N \frac{\Delta B A \cos\theta}{\Delta t}$$

$$= -N \frac{B_f A \cos\theta - B_i A \cos\theta}{\Delta t} \quad (N = 1,\ \theta = 0^\circ)$$

$$= -\frac{(B_f - B_i) A \cos 0^\circ}{\Delta t} = -\frac{(B_f - B_i) A}{\Delta t}$$

$$= -\frac{(9.42 \times 10^{-2}\ T - 7.85 \times 10^{-2}\ T)\pi (.035m)^2}{15 \times 10^{-6}\ sec}$$

$$= \boxed{-4.03\ V} \quad \text{(you can ignore the (-) sign)}$$