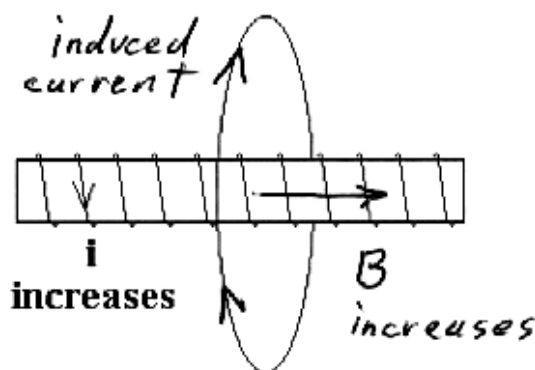


Name: KEY

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 $15 \mu\text{s}$ 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?

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

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

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

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

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

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

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

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

$$= - \frac{(9.42 \times 10^{-2} \text{ T} - 7.85 \times 10^{-2} \text{ T}) \pi (0.035 \text{ m})^2}{15 \times 10^{-6} \text{ s}}$$

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