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?

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

\[ = 7.85 \times 10^{-2} T \]

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

\[ = 9.42 \times 10^{-2} T \]

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

\[ E = -N \frac{\Delta BA \cos \theta}{\Delta t} \]

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

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

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

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