Answer on Question #56080-Physics-Electromagnetism

You need to produce a solenoid that has an inductance of 3.67 μH . You construct the solenoid by uniformly winding 1.09 m of thin wire around a tube. How long, in centimeters, should the tube be?

Solution

$$L = \frac{\mu_0 N^2 A}{z}$$

$$N = \frac{x}{2\pi r} \rightarrow r = \frac{x}{2\pi N}$$

$$A = \pi r^2 = \frac{\pi x^2}{4\pi^2 N^2}$$

$$L = \frac{\mu_0 N^2 A}{z} = \frac{\mu_0 N^2 \pi x^2}{4\pi^2 N^2 z} = \frac{\mu_0 x^2}{4\pi z}.$$

$$z = \frac{\mu_0 x^2}{4\pi L} = \frac{4 \cdot 10^{-7} \cdot (1.09)^2}{4 \cdot 3.67 \cdot 10^{-6}} = 0.032 \, m$$

Answer: $0.032 \, m$.