

Answer on Question #45823 – Physics – Other

What is the self - inductance of an air-core solenoid, 1m long and 0.05m in diameter, if it has 1400 turns?

5.23mH

4.84mH

3.63mH

2.42mH

Solution:

$L = 1\text{m}$ – solenoid length;

$N = 1400$ – number of turns;

$d = 0.05\text{m}$ – deiameter of the solenoid;

The inductance of a coil of wire is given by (A – cross – section area)

$$L = \frac{\mu N^2 A}{L} \quad (1)$$

Formula for the cross-section area using diameter:

$$A = \pi r^2 = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4} \quad (2)$$

(2)in(1):

$$L = \frac{\mu N^2 \frac{\pi d^2}{4}}{L} = \frac{\mu N^2 \pi d^2}{4L} = \frac{4\pi \cdot 10^{-7} \frac{\text{H}}{\text{m}} (1400)^2 \cdot 3.14 \cdot (0.05\text{m})^2}{4 \cdot 1\text{m}} = 4.84 \cdot 10^{-3} \text{H}$$

Answer: 4.84mH