Answer on Question #76457, Physics / Other

A solenoid that is 141 cm long has a radius of 1.61 cm and a winding of 1610 turns; it carries a current of 3.84 A. Calculate the magnitude of the magnetic field inside the solenoid.

Solution:

A solenoid is a coil of wire designed to create a strong magnetic field inside the coil. By wrapping the same wire many times around a cylinder, the magnetic field due to the wires can become quite strong. The number of turns N refers to the number of loops the solenoid has. More loops will bring about a stronger magnetic field.

The field inside an ideal solenoid with turns *N*, length *L*, and current *I* may be calculated from Ampere's law and has magnitude

$$B = \mu_0 I \frac{N}{L}$$

where μ_o is the permeability of free space with value $4\pi \times 10^{-7}$ Tm/A .

The magnetic field inside a solenoid is proportional to both the applied current and the number of turns per unit length. There is no dependence on the diameter of the solenoid, and the field strength doesn't depend on the position inside the solenoid, i.e., the field inside is constant.

So,

$$B = 4\pi \times 10^{-7} \times (3.84\ A) \times \frac{1610}{1.41\ m} = 0.00551\ T$$

Answer: $0.00551\ T$.