Answer on Question 52175, Physics, Electric Circuits

Question:

One end of a simple rectangular wire-loop current balance is inserted into a solenoid. A force of $3.0 \cdot 10^{-3} N$ is found to act on this end when a current of $2.0 A$ is flowing in it. If the length of the conductor forming the end of the wire-loop is $0.10 m$. What is the magnetic flux density in the solenoid?

a) $0.043 T$

b) $0.26 T$

c) $0.43 T$

d) $0.015 T$

Solution:

The magnetic force act on a current-carrying conductor which is inserted into a solenoid because it oriented perpendicular to the magnetic field. We can obtain the magnitude of the magnetic force that act on the end of the current-carrying conductor from the equation $\boldsymbol{F}_B = I\boldsymbol{L} \times \boldsymbol{B}$, where $\boldsymbol{F}_B$ is the magnetic force, I is the current in the conductor, $\boldsymbol{L}$ is a vector that points in the direction of the current I and has a magnitude equal to the length L of the conductor, $\boldsymbol{B}$ is the magnetic field. Therefore, the magnitude of this force is:

$$F = ILB.$$

From this equation we can find the magnetic flux density in the solenoid:

$$B = \frac{F}{IL} = \frac{3.0 \cdot 10^{-3} N}{2.0 A \cdot 0.10 m} = 0.015 T$$

Answer:

d) $0.015 T$