Answer on Question 59444, Physics, Electromagnetism

Question:

An electron with momentum $5.60 \cdot 10^{-19}\ kgms^{-1}$ moves in a circle of radius $5\ m$ in uniform magnetic field. What is the magnitude of the magnetic field?

Solution:

There are two forces that act on the electron when it moves in a circle in the uniform magnetic field: the magnetic force and the radial force (this one is required to keep the electron moving in a circle). So, using the Newton's second law of motion we can write:

$$evB = \frac{mv^2}{r},$$

here, $e = -1.6 \cdot 10^{-19}C$ is the charge of the electron, v is the orbital speed of the electron, B is the magnetic field, m is the mass of the electron, r is the radius of the electron's circular orbit.

Let's simplify the last formula, we get:

$$erB = mv = p,$$

here, $p = mv$ is the momentum of the electron and we already know it from the condition of the task.

Then, from this formula we can find the magnitude of the magnetic field, B:

$$B = \left|\frac{p}{er}\right| = \left|\frac{5.60 \cdot 10^{-19}\ kgms^{-1}}{-1.6 \cdot 10^{-19}\ C \cdot 5.0\ m}\right| = 0.7\ T.$$

The magnitude of the magnetic field is equal to $0.7\ T$.

Answer:

$B = 0.7\ T.$