Answer on Question #40331 – Physics – Electrodynamics

1. A charged particle is moving in a circular orbit of radius 6 cm with a uniform speed of 3x10^6 m/s under action of a uniform magnetic field 2x10^-4 wb/m at right angle to the plane of the orbit. The charge to mass ratio of the particle is: A) 5x10^9 C/kg; B) 2.5x10^11C/kg; C) 5x10^11C/kg; D) 5x10^12 C/kg.

$r = 0.06\, m$

$v = 3\cdot 10^6\ \frac{m}{s}$

$B = 2\cdot 10^{-4}\ \frac{wb}{m}$

$\alpha = 90^0$

$\frac{q}{m} - ?$

Solution.

Let write down the second law of Newton for the particle, moving in the magnetic field: $m a = F$,

where the acceleration in a circular orbit is $a = \frac{v^2}{r}$ and the Lorentz force is $F = qvB\sin\alpha$.

So, $m\frac{v^2}{r} = qvB\sin\alpha$.

The charge to mass ratio of the particle is: $\boxed{\frac{q}{m} = \frac{v}{rB\sin\alpha}}$.

Let check the dimension.

$$\left[\frac{q}{m}\right] = \frac{m/s}{m\cdot wb} = \frac{1}{wb\cdot s} = \frac{C}{kg}.$$

Let evaluate the quantity.

$$\frac{q}{m} = \frac{3\cdot 10^6}{0.06\cdot 2\cdot 10^{-4}\cdot \sin 90^0} = 2.5\cdot 10^{11}\left(\frac{C}{kg}\right).$$

Answer: *B.*