Question #74684, Physics / Electromagnetism |

An electron of mass 0.90×10 power -30 kg under the action of a magnetic force moves in a circle of 2.0 cm radius at a speed of 3.0×10 power 6m/sec . if proton of mass 1.8×10 power -27 kg were to move in circle of the same radius and if it were acted upon by the same magnetic field then its speed will be (1)3.0×10 power 6 m/sec (2) 1.5× 10 power 3m/sec (3) 6×10 power 4m/sec (4) can not be estimated from given data .

Need to find v_p−?

$\boldsymbol{m_e} = 9.0\text{x}10^{-31}\ kg$

$\boldsymbol{m_p} = 1.8\text{x}10^{-27}\ kg$

$\boldsymbol{v_e} = 3.0\text{x}10^{6}\ {}^{m}/_{S}$

$|\boldsymbol{q_e}| = |\boldsymbol{q_p}| = 1.6\text{x}10^{-19}\ C$

$\boldsymbol{R} = 2.0\ cm = 2.0\text{x}10^{-2}\ m$

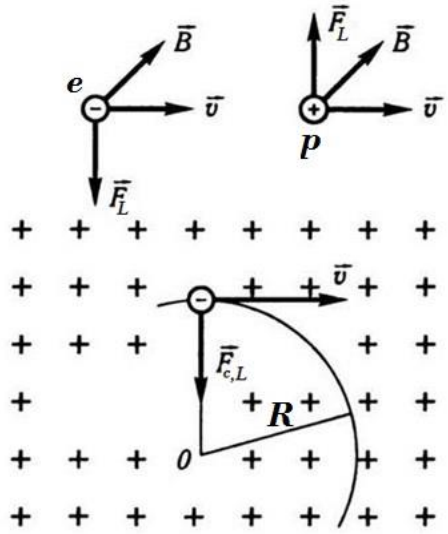
Solution:

Lorentz force $\boldsymbol{F_L = evB}$, from picture can be seen, that $\boldsymbol{F_L = F_c}$.

$\boldsymbol{m\frac{v^2}{r} = evB \rightarrow B = \frac{m_e v_e}{q_e R}}$. Let's calculate $\boldsymbol{B}$: $\boldsymbol{B = \frac{9.0\text{x}10^{-31}\cdot 3.0\text{x}10^{6}}{1.6\text{x}10^{-19}\cdot 2.0\text{x}10^{-2}} = 8.4\text{x}10^{-4}\ T}$.

For proton – $\boldsymbol{v_p = \frac{q_p}{m_p} BR = \frac{1.6\text{x}10^{-19}}{1.8\text{x}10^{-27}}\cdot 8.4\text{x}10^{-4}\ \cdot 2.0\text{x}10^{-2} = 1,5\text{x}10^{3}}$.

The sign of the charge of particles, affects only the direction of force of Lorentz.



Answer: (2) - $\boldsymbol{v_p = 1,5\text{x}10^{3}\ {}^{m}/_{S}}$.