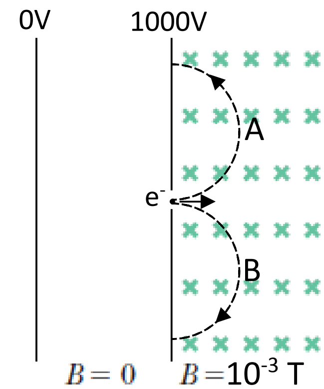
Name: ______________________________

PHY 232 Summer 2016 Class Work

Class 25. Magnetic Force on Moving Charge and Current



An electron of charge -1.602×10^{-19} C and mass 9.109×10^{-31} kg accelerated through a potential difference of 1000V before entering a region of uniform magnetic field of 10^{-3} T as shown in the figure.

(a) What is the speed of the electron before entering the uniform magnetic field region?

Solution:

$$\Delta KE + \Delta PE = 0 \Rightarrow \frac{1}{2}mv^2 + qV = 0$$

$$\Rightarrow \frac{1}{2}(9.109\times10^{-31})v^2 + (-1.602\times10^{-19})(1000) = 0$$

$$\Rightarrow v^2 = \frac{(2)(1.602\times10^{-19})(1000)}{9.109\times10^{-31}}$$

$$\Rightarrow v^2 = 3.518\times10^{14}$$

$$\Rightarrow v = \underline{\underline{1.876\times10^{7}\ \text{m/s}}}$$

(b) Along which path will the electron move, A or B?

As the electron first enters the magnetic region, the magnetic force (opposite to $\vec{v}\times\vec{B}$ as electron has negative charge) is pointing downward, so it must follow path B.

(c) What is the radius of the semicircular path?

Solution:

$$qvB = m\frac{v^2}{R} \Rightarrow R = \frac{mv}{qB}$$

$$\Rightarrow R = \frac{(9.109\times10^{-31})(1.876\times10^{7})}{(1.602\times10^{-19})(1\times10^{-3})}$$

$$\Rightarrow R = \underline{\underline{0.107\text{m}}}$$

(d) It will take how long for the electron to complete the semicircular path?

Solution:

$$t = \frac{\pi R}{v} \Rightarrow t = \frac{0.107\pi}{1.876\times10^{7}}$$

$$\Rightarrow t = \underline{\underline{1.786\times10^{-8}\ \text{s}}}$$