Quiz Average **3.20** **Quiz High Score** **6**

PH 221 **Quiz # 06 (10 pts)** **Name** **Solution**

An object has a charge $(\mathrm{Q} = -5.67\ \mathrm{mC})$, a mass $(\mathrm{m} = 9.87\ \mathrm{x}\ 10^{-4}\ \mathrm{kg})$, and is traveling with a velocity $\left(\mathrm{v} = 1.38\ \mathrm{x}\ 10^{3}\ {}^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{East}})\right)$. The object enters a magnetic field described by $\vec{\mathrm{B}} = 4.08\ \mathrm{x}\ 10^{-3}\ \mathrm{T}\ (\widehat{\mathrm{South}})$. What is the magnetic force that acts on the object?

A. $\mathbf{3.19\ x\ 10^{-2}\ N\ (\widehat{Up})}$

B. $3.23\ \mathrm{x}\ 10^{1}\ \mathrm{N}\ (\widehat{\mathrm{Up}})$

C. $3.23\ \mathrm{x}\ 10^{1}\ \mathrm{N}\ (\widehat{\mathrm{Down}})$

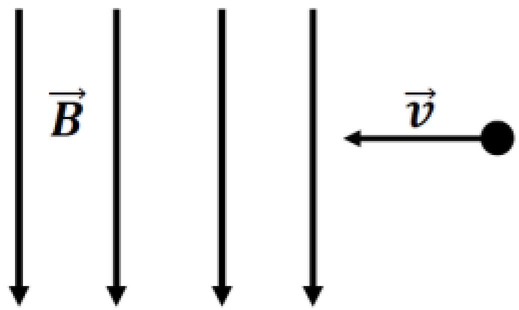
D. $3.19\ \mathrm{x}\ 10^{-2}\ \mathrm{N}\ (\widehat{\mathrm{Down}})$

$$\boldsymbol{\overrightarrow{F_B} = Q\vec{v}\ x\ \vec{B} = (-5.67\ x\ 10^{-3}\ C)\left(\left(1.38\ x\ 10^{3}\ {}^{m}/_{s}\ (\widehat{East})\right)x\left(4.08\ x\ 10^{-3}\ T\ (\widehat{South})\right)\right)}$$

$$\boldsymbol{\overrightarrow{F_B} = (-5.67\ x\ 10^{-3}\ C)(1.38\ x\ 10^{3}\ {}^{m}/_{s})\ (4.08\ x\ 10^{-3}\ T)\left((\widehat{East})\ x\ (\widehat{South})\right)}$$

$$\boldsymbol{\overrightarrow{F_B} = -3.19\ x\ 10^{-2}\ N\ (\widehat{Down}) = 3.19\ x\ 10^{-2}\ N\ (\widehat{Up})}$$

So, the correct answer is A !



An ion has a charge $(Q = +4.80 \text{ x } 10^{-19} \text{ C})$ and a mass $(m = 4.45 \text{ x } 10^{-25} \text{ kg})$. The ion is traveling with a velocity $\left(\vec{v} = 6.21 \text{ x } 10^4 \ {}^{m}/_{s} \ \widehat{(-\imath)}\right)$. The ion enters a magnetic field $\left(\vec{B} = 0.705 \text{ T } \widehat{(-\jmath)}\right)$. What is the magnitude and direction of an electric field which would need to be added to this situation to cause the ion to travel in a straight line undeflected?

A. $8.81 \text{ x } 10^4 \ {}^{N}/_{C} \ \widehat{(\odot)}$

B. $4.38 \text{ x } 10^4 \ {}^{N}/_{C} \ \widehat{(\odot)}$

C. $8.81 \text{ x } 10^4 \ {}^{N}/_{C} \ \widehat{(\otimes)}$

D. $\mathbf{4.38 \text{ x } 10^4 \ {}^{N}/_{C}} \ \widehat{(\otimes)}$

$$\vec{F_B} = Q\vec{v} \, x \, \vec{B} = (+4.80 \, x \, 10^{-19} \, C)\left(\left(6.21 \, x \, 10^4 \ {}^{m}/_{s} \ \widehat{(-\imath)}\right) x \left(0.705 \, T \ \widehat{(-\jmath)}\right)\right)$$

$$\vec{F_B} = 2.10 \, x \, 10^{-14} \, N \ \widehat{(\odot)}$$

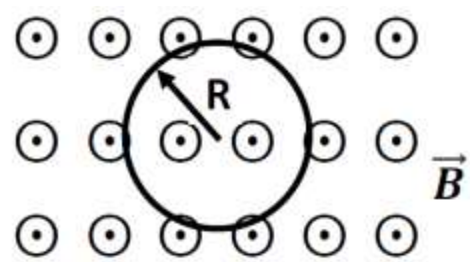
To be undeflected,

$$\vec{F_E} = Q\vec{E} = -\vec{F_B} = -2.10 \, x \, 10^{-14} \, N \ \widehat{(\odot)} = 2.10 \, x \, 10^{-14} \, N \ \widehat{(\otimes)}$$

$$\vec{E} = \frac{2.10 \, x \, 10^{-14} \, N \ \widehat{(\otimes)}}{Q} = \frac{2.10 \, x \, 10^{-14} \, N \ \widehat{(\otimes)}}{+4.80 \, x \, 10^{-19} \, C} = 4.38 \, x \, 10^4 \ {}^{N}/_{C} \ \widehat{(\otimes)}$$

So, the correct answer is D !

An object has a mass $(\mathrm{m} = 9.06 \times 10^{-2}\ \mathrm{kg})$ and a charge $(\mathrm{Q} = +3.96 \times 10^{-2}\ \mathrm{C})$ is moving around a circle with radius $(\mathrm{R} = 0.698\ \mathrm{m})$ which sits inside a magnetic field $(\vec{\mathrm{B}} = 0.666\ \mathrm{T}\ (\widehat{\odot}))$ as shown on the right. How long does it take the object to complete one revolution around the circle and does it go Clockwise or Counter-Clockwise around the circle?



A. 21.6 s, Counter-Clockwise

B. **21.6 s, Clockwise**

C. 15.1 s, Counter-Clockwise

D. 15.1 s, Clockwise

For the object to make a circular revolution, the magnetic force must point into the center of the circle. Consider the object at the 6 o'clock position, using the magnetic force equation and recalling the charge is positive

$$\overrightarrow{F_B} = Q\vec{v}\ x\ \vec{B}$$

The velocity at the 6 o'clock position must point to the left, so the direction of rotation is Clockwise! The period can be found from:

$$v = \frac{2\pi R}{T}$$

And

$$qvB = \frac{mv^2}{R}$$

Solve both of these for $\frac{v}{R}$ and set them equal

$$\frac{v}{R} = \frac{2\pi}{T} = \frac{QB}{m}$$

Solve for period

$$T = \frac{2\pi m}{QB} = \frac{2\pi(9.06\ x\ 10^{-2}\ kg)}{(3.96\ x\ 10^{-2}\ C)(0.666\ T)} = \frac{0.5693\ kg}{2.637\ x\ 10^{-2}\ C\ T} = 21.6\ s$$

So, the correct answer is B !

A straight piece of wire has length $(L = 1.67\ m)$, mass $(m = 0.124\ kg)$ and lies along the East-West direction. The horizontal component of the Earth's magnetic field at this location is given as $\left(\overrightarrow{B_{EHoriz}} = 4.56 \times 10^{-5}\ T\ (\widehat{North})\right)$. How much current and in which direction must it be going to have the wire "Float" above the ground?

A. 6.25×10^{-5} A, To the West

B. 1.60×10^{4} A, To the West

C. 6.25×10^{-5} A, To the East

D. $\mathbf{1.60 \times 10^{4}}$ **A, To the East**

For the wire to "Float" the magnetic force must act Up against gravity which of course acts Down.

$$\overrightarrow{F_B} = i\vec{L} \times \vec{B} = iLB\left((\widehat{?}) \times (\widehat{North})\right) = iLB\ (\widehat{Up})$$

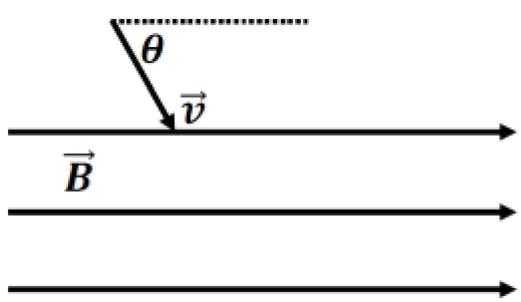
$$(\widehat{East}) \times (\widehat{North}) = (\widehat{Up})$$

So current must go to the East!

$$iLB = mg$$

$$i = \frac{mg}{LB} = \frac{(0.124\ kg)\left(9.80\ {}^{m}/_{s^2}\right)}{(1.67\ m)(4.56 \times 10^{-5}\ T)} = \frac{1.2152\ {}^{kg}/_{s^2}}{7.6152 \times 10^{-5}} = 1.60 \times 10^{4}\ A$$

So, the correct answer is D !



A particle has a mass $(m = 5.31 \times 10^{-3}\ kg)$, a charge $(+0.492\ C)$, and is traveling with a velocity $\left(\vec{v} = 7.79 \times 10^{2}\ {}^{m}/_{s}\ @37.0° \text{ below } (\widehat{+\imath})\right)$ as shown on the left. The particle enters a magnetic field $\left(\vec{B} = 0.318\ T\ (\widehat{+\imath})\right)$. The magnetic force that occurs results in the particle following a helical path. What is the radius of the helix?

A. 21.1 m

B. 26.4 m

C. **15.9 m**

D. 31.8 m

$$R = \frac{mv\sin(\theta)}{QB} = \frac{(5.31 \times 10^{-3}\ kg)(7.79 \times 10^{2}\ {}^{m}/_{s})\sin(37.0°)}{(0.492\ C)(0.318\ T)} = \frac{2.489\ {}^{kg\ m}/_{s}}{1.565 \times 10^{-1}\ C\ T}$$

$$R = 15.9\ m$$

So, the correct answer is C !