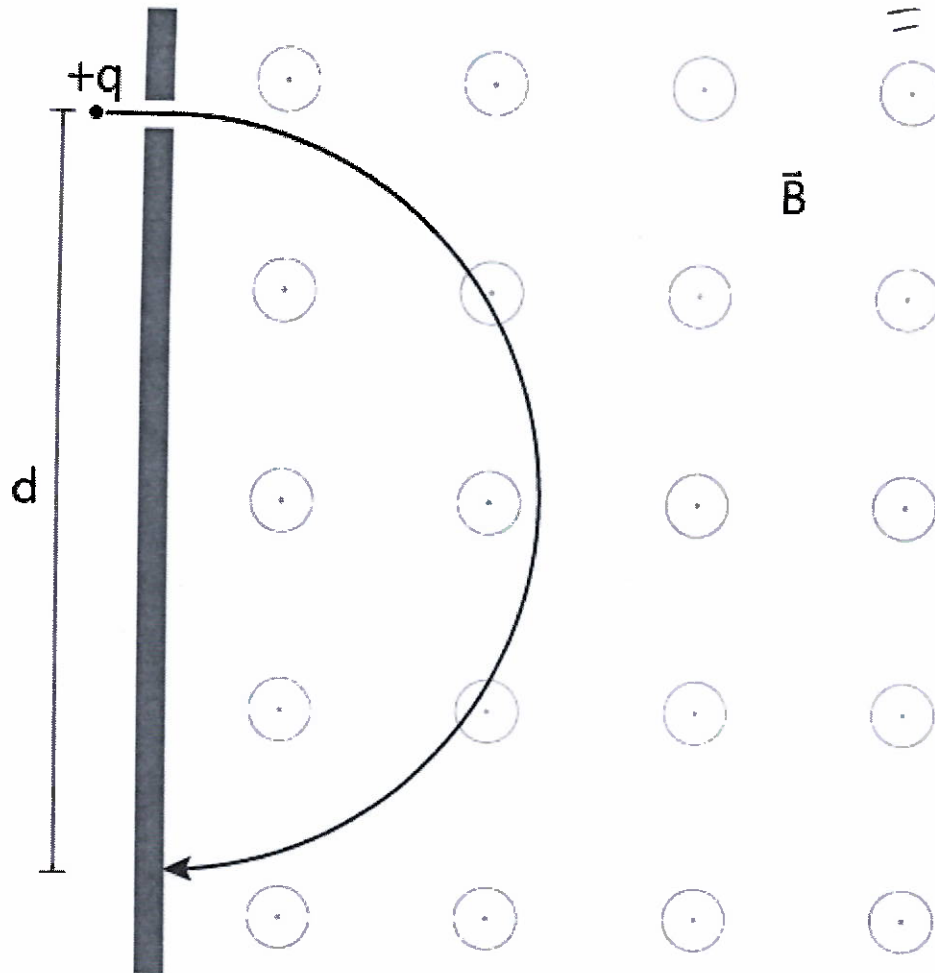


= HW 6 =
= KEY =



$$F = q(\vec{E} + \vec{v} \times \vec{B})$$

$$a) F = qvB \sin \theta \quad \theta = \pi/2$$

$$= (2.1 \times 10^{-6}) (2350 \times 10^3) (1.0)$$

$$F = 4.935$$

$$b) \text{ NOTE THIS } F = m \frac{v^2}{R}$$

$$\Rightarrow R = \frac{F}{m v^2}$$

$$R = \frac{4.935}{(5.4 \times 10^{-12}) (2.350 \times 10^6)^2}$$

A charge $q = 2.10 \mu\text{C}$ having mass $m = 5.40 \times 10^{-12} \text{ kg}$ has a speed of $v = 2350 \text{ km/s}$ $\hat{x}$. It travels into a place with a constant magnetic field $\vec{B} = 1.00 \text{ T } \hat{y}$ as shown. (a) How big is the force on the particle while in the magnetic field? (b) As illustrated in the picture, compute the distance from where the particle enters the field region to the point of impact on the wall?

(a) N ☒ Answer part (a)

(b) m ☒ Answer part (b)

$$\Rightarrow R = 0.1655 \text{ m}$$

$$\text{So } d = 2R = 0.331 \text{ m}$$

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

Problem #2

A wire of length $\ell = 2.50\text{m}$ carries a current of $I = 5.30\text{A}$ in a region where there is a constant magnetic field with magnitude $|\mathbf{B}| = 0.430\text{T}$. Find the magnitude of the magnetic force on the wire when the angle between the magnetic field and wire is (a) 30° , (b) 60° , (c) 90° , and (d) 120° .

(a) N ☒ Answer part (a)

(b) N ☒ Answer part (b)

(c) N ☒ Answer part (c)

(d) N ☒ Answer part (d)

Submit

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

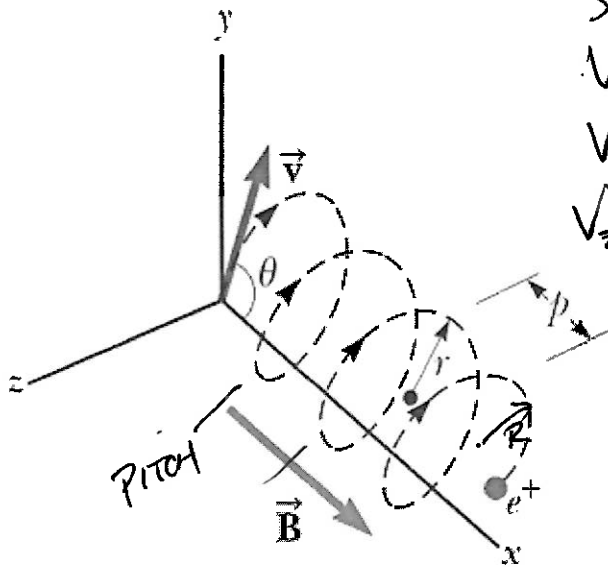
There have been no attempts to answer part (d)

$$F = B I \sin \theta \ell$$

$$F = (0.43)(5.3)(\sin 30^\circ)(2.5) = 2.85\text{N}$$

$\therefore$ others VERY SIMILAR...

Problem #3



So 1st DETERMINE THE PITCH BY BREAKING V INTO COMPONENTS $\parallel$ & $\perp$ TO THE B-FIELD

$$V_x = V \cos \theta = (5.35 \times 10^6 \text{ m/s}) \cos 85.1^\circ = 0.457 \times 10^6 \text{ m/s}$$

$$V_{z-y} = V \sin \theta = (5.35 \times 10^6 \text{ m/s}) \sin 85.1^\circ = 5.33 \times 10^6 \text{ m/s}$$

a) For PITCH, TAKE $\tau = V_x \cdot t_{\text{orbit}}$

$$\omega_c = \left(\frac{eB}{m_e} \right) = \frac{1.6 \times 10^{-19} \cdot 1.10}{9.11 \times 10^{-31}} = 1.93 \times 10^{11} \text{ rad/s}$$

$$\Rightarrow 2\pi f = \omega_c \quad t_{\text{orbit}} = \frac{1}{f} = \frac{2\pi}{\omega_c} = \frac{2\pi}{1.93 \times 10^{11}} = 3.25 \times 10^{-11} \text{ s}$$

PITCH = ~~6.33 m~~

PITCH = $V_x t_{\text{orbit}} = 1.49 \times 10^{-5} \text{ m}$

A uniform magnetic field of magnitude 1.10 T is oriented along the x-axis. A positron ($e^+ = 1.602 \times 10^{-19} \text{ C}$ and $m_e = 9.109 \times 10^{-31} \text{ kg}$) moving at a speed of 5350 km/s enters the field along a direction that makes an angle of $\theta = 85.1^\circ$ with the x-axis. The motion of the particle is expected to be a helix as shown in the above diagram. What is the (a) pitch and (b) radius of the helical trajectory?

(a) μm ☒ Answer part (a)

(b) μm ☒ Answer part (b)

b) For CYCLOTRON ORBIT $\rightarrow$
 $v = \omega R \quad R = \frac{v}{\omega}$

$$R = \frac{5.33 \times 10^6}{1.93 \times 10^{11}} = 2.75 \times 10^{-5} \text{ m}$$

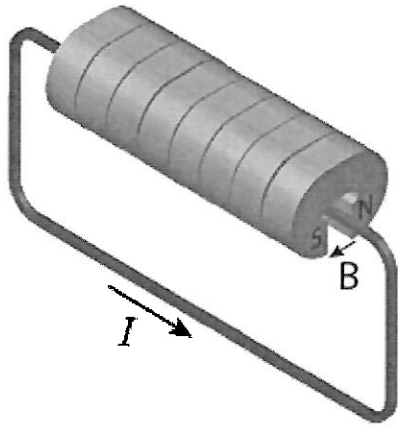
Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

Problem #4



LIFE SUSPENDING WIRE, SCASS.

$$L = 8(0.0135) = 0.108$$

a) $F = BIL = mg$
 $(0.111)(5.1)(0.108) = m(9.8) \Rightarrow \underline{m = 0.0062 \text{ kg}}$

A wire carrying a current of $I = 5.10\text{A}$ is shaped into a rectangle. It runs through the field region of a collection of eight aligned magnets held together and held as in the figure, each magnet having a thickness of $t = 1.35\text{cm}$ and a magnetic field $|B| = 0.111\text{T}$. (a) If the wire is hanging in equilibrium, then what is the mass of the wire rectangle? (b) If a nonmagnetic mass of $m_h = 10.5\text{g}$ is hung from the bottom of the wire, then by what factor must the current be increased to remain in equilibrium?

(a) g

☒ Answer part (a)

(b)

☒ Answer part (b)

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

b) Now Mass $m = 0.0062 + 0.0105$
 $= 0.0167$

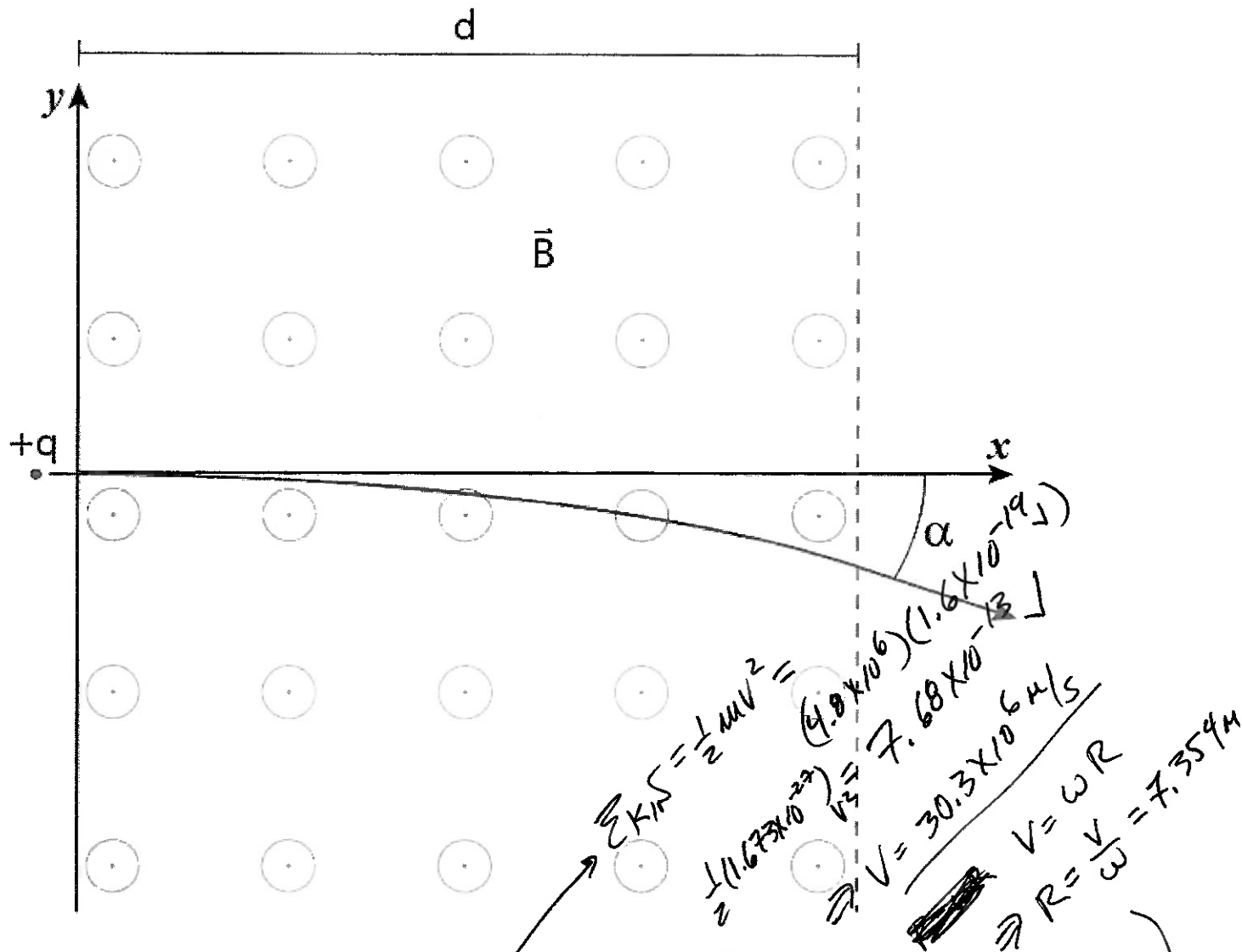
$$F = BIL = mg$$

$$(0.111)(I)(0.108) = (0.0167)(9.8)$$

$$I = 13.68 \text{ Amps}$$

$$\Rightarrow \text{INCREASE OF } \frac{13.68}{5.1} = \underline{2.68 \text{ TIMES}}$$

Problem #5



A proton ($e^+ = 1.602 \times 10^{-19} \text{ C}$ and $m_p = 1.673 \times 10^{-27} \text{ kg}$) having a kinetic energy of $K = 4.80 \text{ MeV}$ ($1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$) is moving to the right as it encounters an area with a magnetic field of magnitude $|\vec{B}| = 0.0430 \text{ T}$ directed out of the plane of the page as shown in the above figure. The magnetic field extends a distance of $d = 1.10 \text{ m}$. Ignoring relativistic effects, determine the angle α that the trajectory finally makes with the initial trajectory.

8.6

☒ Answer the question

Submit

Attempted the problem 0 times.

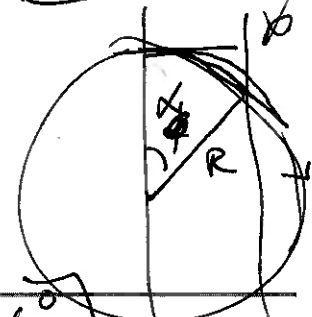
There have been no attempts to answer the problem

$$\omega_c = \frac{qB}{m} = 4.12 \times 10^6 \text{ rad/s}$$

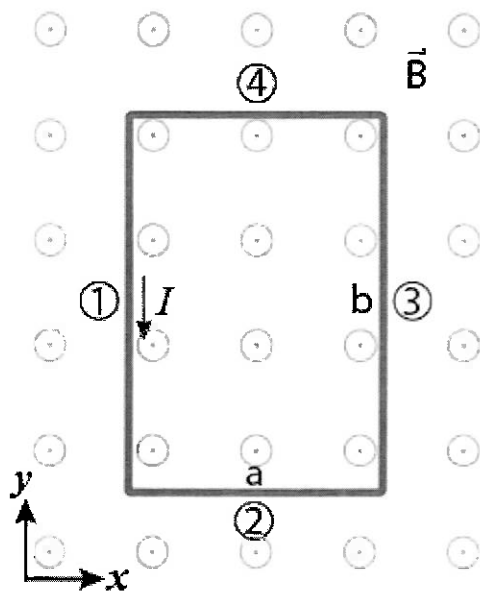
$$R \sin \alpha = d$$

$$\sin \alpha = \frac{d}{R}$$

$$\alpha = 8.6^\circ$$



Problem #6



$$\begin{aligned} \text{a) } F &= BIL \\ &= (0.82)(5.3)(0.83) \quad \text{to } -\hat{x} \\ &= \boxed{-3.61 \hat{x}} \end{aligned}$$

$$\begin{aligned} \text{b) } F &= BIL \\ &= (0.82)(5.3)(0.53) \quad \text{to } -\hat{y} \\ &= \boxed{-2.3 \hat{y}} \end{aligned}$$

As shown in the above diagram, a square wire of side lengths $a = 0.530\text{m}$ and $b = 0.830\text{m}$ is in a magnetic field of magnitude $|\mathbf{B}| = 0.820\text{T}$ that is oriented along the positive z -axis. When the wire carries a current of $I = 5.30\text{A}$, calculate the force on sides (a) ①, (b) ②, (c) ③, and (d) ④.

(a) N $\hat{x}$ ☒ Answer part (a)

(b) N $\hat{y}$ ☒ Answer part (b)

(c) N $\hat{x}$ ☒ Answer part (c)

(d) N $\hat{y}$ ☒ Answer part (d)

Submit

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

There have been no attempts to answer part (d)

Problem #7

STEP 1: ACCELERATION $eV = \frac{1}{2}mv^2$
 STEP 2: BEND IN FIELD $Rv = \frac{mv}{B}$ $\omega = \frac{eB}{m}$

A singly charged ion of mass m is accelerated from rest by a potential difference ΔV . It is then deflected by a uniform magnetic field (perpendicular to the ion's velocity) into a semicircle of radius R . Now a triply charged ion of mass m' is accelerated through the same potential difference and deflected by the same magnetic field into a semicircle of radius $R' = 2R$. What is the ratio of the masses of the ions, m'/m ?

12

☒ Answer the question

Submit

PARTICLE 1: $R = \frac{\sqrt{2eV}}{m} / \left(\frac{eB}{m}\right) = \frac{\sqrt{m2V}}{eB}$

PARTICLE 2: $2R = \frac{\sqrt{m'2V}}{3eB}$

$\Rightarrow \div \Rightarrow 2 = \sqrt{\frac{m'}{3m}}$

Attempted the problem 0 times.

There have been no attempts to answer the problem

Problem #8

A cyclotron accelerates protons ($e^+ = 1.602 \times 10^{-19} \text{C}$ and $m_p = 1.673 \times 10^{-27} \text{kg}$) via a magnetic field of magnitude $|B| = 0.510 \text{T}$ over a region of radius $R = 1.10 \text{m}$. (a) What is the cyclotron frequency? (b) What is the maximum speed of the protons?

(a) 7.766 MHz ☒ Answer part (a)

(b) 53.7 $\times 10^6 \text{m/s}$ ☒ Answer part (b)

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)