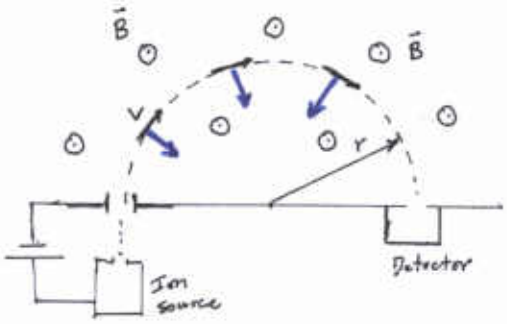
Name_____ Units? Units?

Phys 2020

Quiz #3 — Fall 2002

1. A singly–charged positive ion has a mass of 3.14×10^{-26} kg. After being accelerated through a potential difference, the ion enters a uniform magnetic field of 0.250 T, in a direction perpendicular to the field. The radius of the ion's path is 4.80 cm.



$q = +e$

a) What is the speed of the particle?

r, q, m, v, B related by: $r = \frac{mv}{qB}$. Then:

$$v = \frac{rqB}{m} = \frac{(4.80\times10^{-2}\,m)(1.602\times10^{-19}\,C)(0.250\,T)}{(3.14\times10^{-26}\,kg)}$$

$$= \boxed{6.12\times10^{4}\ m/s}$$

b) What is the kinetic energy of the particle? Express the answer in eV (electron-volts).

$$KE = \tfrac{1}{2}mv^2 = \tfrac{1}{2}(3.14\times10^{-26}\,kg)(6.12\times10^{4}\,m/s)^2$$

$$= 5.88\times10^{-17}\,J\left(\frac{1\,eV}{1.602\times10^{-19}\,J}\right) = \boxed{367\,eV}$$

c) Through what potential was the ion accelerated? (Recall the ion was single–charged.)

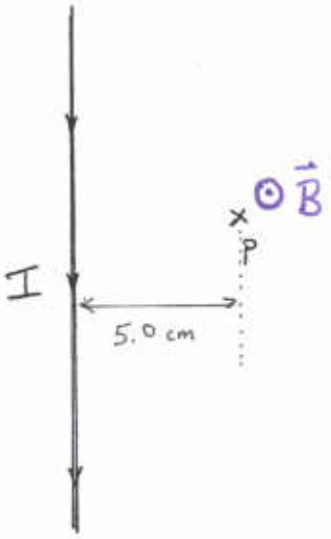
Since $KE = q\Delta V = 367\,eV$ and $q = +e$ (and $1eV = e\cdot Volt$)

then $\Delta V = \boxed{367\,V}$

d) On the figure, note down the direction of the magnetic force at a couple places on the ion's path.

Force points toward center of circle!

2. A wire carries a current of 6.00 A, in the direction shown (in the plane of the page). A particle with charge $q = +6.40 \times 10^{-19}$ C

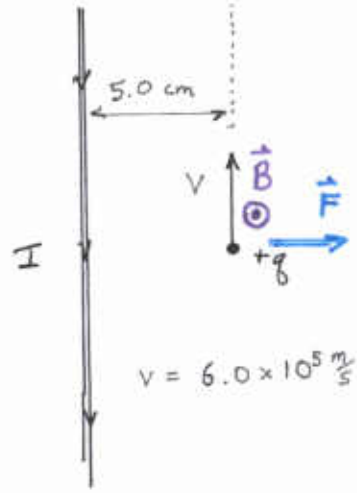


a) What is the magnitude and direction of the magnetic field at the point labelled P?

By RHR-2 w/ thumb along I fingers come out of page at P, so $\vec{B}$ goes out of the page.

$$B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A} \cdot (6.0\text{A})}{2\pi\ (5.0 \times 10^{-2}\text{m})} = \boxed{2.4 \times 10^{-5}\ \text{T}}$$

b) A particle with charge $q = +6.40 \times 10^{-19}$ C is moving parallel to the wire, as shown. What is the direction of the magnetic force acting on the particle? *Say a few words as to how you arrived at this result.*



Since $\vec{B}$ comes out of page by RHR-1 (thumb along $\vec{v}$, fingers along $\vec{B}$: palm faces outward!) force goes **outward** (as shown).

c) What is the magnitude of the magnetic force which acts on this particle?

$$F = qvB \cdot 1 = (6.40 \times 10^{-19}\text{C})(6.0 \times 10^5 \tfrac{\text{m}}{\text{s}})(2.4 \times 10^{-5}\text{T})$$
$$= \boxed{9.2 \times 10^{-18}\ \text{N}}$$

You must show all your work and include the right units with your answers!

$e = 1.602 \times 10^{-19}$ C $\quad \mu_0 = 4\pi \times 10^{-7}\ \frac{\text{T}\cdot\text{m}}{\text{A}} \quad 1\ \text{eV} = 1.602 \times 10^{-19}\ \text{J} \quad \Delta\text{EPE} = q\Delta V$

$F = qvB\sin\theta \quad F = ILB\sin\theta \quad \text{KE} = \frac{1}{2}mv^2 \quad F_c = \frac{mv^2}{r} \quad r = \frac{mv}{qB}$

$B_{\text{wire}} = \frac{\mu_0 I}{2\pi r} \quad B_{\text{coil}} = \frac{N\mu_0 I}{2R} \quad B_{\text{sol}} = \mu_0 nI \quad \mathcal{E}_{\max} = NAB\omega \quad \omega = 2\pi f$